LOWER ARKANSAS BASIN TOTAL MAXIMUM DAILY LOAD

Waterbody / Assessment Unit: Little Arkansas River Watershed
Water Quality Impairment: Total Suspended Solids (TSS)

1. INTRODUCTION AND PROBLEM IDENTIFICATION

Subbasin: Little Arkansas

Counties: Ellsworth, Rice, McPherson, Reno, Harvey, Marion, and Sedgwick

HUC 8: **11030012**
HUC 10(12): **01** (01, 02, 03, 04, 05, 06, 07)
02 (01, 02, 03, 04, 05, 06, 07, 08, 09)
03 (01, 02, 03, 04, 05, 06, 07)
04 (01, 02, 03, 04, 05, 06, 07, 08)
05 (01, 02)

Ecoregion: Central Great Plains, Smoky Hills, 27a
Central Great Plains, Great Bend Sand Prairie, 27c
Central Great Plains, Wellington-McPherson Lowland, 27d

Drainage Area: Approximately 1,422 Square Miles

Main Stem Water Quality Limited Segments: Little Arkansas River (Segments 1, 3, 5, 9, 10, 14); Turkey Creek (11 and 12); Black Kettle Creek (368); and Kisiwa Creek (15).

Water Quality Limited Segments Covered Under this TMDL

Station	***Main Segment***	***Trib 1***	***Trib2***
Station 533	**Turkey Creek (11)**	Dry Turkey Cr (13)	Bull Cr (24)
	Turkey Creek (12)	Running Turkey Cr (25)	
Station 246	**Little Arkansas River (10-part)**		
	Little Arkansas River (14)	Sand Cr (23)	
		Lone Tree Cr (20)	
		Dry Cr (22)	
		Salt Cr (21)	
		Horse Cr (19)	
Station 705	**Black Kettle Cr (368)**		
Station 703	**Kisiwa Cr (15)**		

Station 282	**Little Arkansas R (1-part)**	Jester Cr (2)	Gooseberry Cr (17) W. Fk. Jester Cr (18)
	Little Arkansas R (3)		
	Little Arkansas R (5)		
	Little Arkansas R (9)		
	Little Arkansas R (10-part)		
Station 728	**Little Arkansas R (1-part)**	Middle Fk Chisholm Cr (817) Chisholm Cr (1693)	

Non-Water Quality Limited Segments Covered Under this TMDL

Station 534	**Emma Cr (6)**	Middle Emma Cr (7) West Emma Cr (8)
Station 535	**Sand Cr (4)**	Mud Cr (16) Beaver Cr (26)

2012 303(d) Listing: Kansas Stream segments monitored by stations SC533, SC246, SC705, SC703, SC282, and SC728 are cited as impaired by Total Suspended Solids (TSS) for the Lower Arkansas Basin. Stations SC534 on Emma Creek and SC535 on Sand Creek are not cited for suspended solids, since the median concentration at these stations did not exceed the listing threshold.

Impaired Use: Expected Aquatic Life.

Water Quality Criteria:
Suspended Solids: Suspended solids added to surface waters by artificial sources shall not interfere with the behavior, reproduction, physical habitat, or other factors related to the survival and propagation of aquatic or semiaquatic life or terrestrial wildlife. In the application of this provision, suspended solids associated with discharges of pre-sedimentation sludge from water treatment facilities shall be deemed noninjurious to aquatic and semiaquatic life and terrestrial wildlife, if these discharges comply fully with the requirement of paragraphs (b)(6) and (8) and paragraph (c)(2)(D) of this regulation. (K.A.R. 28-16-28e(c)(2)(B)).

Other Related Water Quality Criteria:
Surface waters shall be free, at all time, from the harmful effects of substances that originate from artificial sources of pollution and that produce any public health hazard, nuisance condition, or impairment of a designated use. (K.A.R. 28-16-28e(b)(1)).

Hazardous materials derived from artificial sources, including toxic substances, radioactive isotopes, and infectious microorganisms derived directly or indirectly from point or nonpoint sources, shall not occur in surface waters at concentrations or in combinations that jeopardize the public health or the survival or well-being of livestock, domestic animals, terrestrial wildlife, or aquatic or semiaquatic life. (K.A.R. 28-16-28e(b)(2)).

Surface waters shall be free of all discarded solid materials, including trash, garbage, rubbish, offal, grass clippings, discarded building or construction materials, car bodies, tires, wire, and other unwanted or discarded materials. The placement of stone and concrete rubble for bank stabilization shall be acceptable to the department, if all other required permits are obtained before placement. (K.A.R. 28-16-28e(b)(3)).

Surface waters shall be free of floating debris, scum, foam, froth, and other floating materials directly or indirectly attributable to artificial sources of pollution. (K.A.R. 28-16-28e(b)(4)).

Oil and grease from artificial sources shall not cause any visible film or sheen to form upon the surface of the water or upon submerged substrate or adjoining shorelines, nor shall these materials cause a sludge or emulsion to be deposited beneath the surface of the water or upon the adjoining shorelines. (K.A.R. 28-16-28e(b)(5)).

Surface waters shall be free of deposits of sludge or fine solids attributable to artificial sources of pollution. (K.A.R. 28-16-28e(b)(6)).

Taste-producing and odor-producing substances or artificial origin shall not occur in surface waters at concentrations that interfere with the production of potable water by conventional water treatment processes, that impart an unpalatable flavor to edible aquatic or semiaquatic life or terrestrial wildlife, or that result in noticeable odors in the vicinity of surface waters. (K.A.R. 28-16-28e(b)(7)).

The natural appearance of surface waters shall not be altered by the addition of color-producing or turbidity-producing substance of artificial origin. (K.A.R. 28-16-28e(b)(8)).

Conditions of acute toxicity shall not occur in classified surface waters outside the zones of initial dilution, nor shall conditions of chronic toxicity occur in classified surface waters outside of mixing zones. (K.A.R. 28-16-28e(c)(2)(D)(i)).

If a discharge contains a toxic substance that lacks any published criteria for the aquatic life support use, or if a discharge contains a mixture of toxic substance capable of additive or synergistic interactions, bio assessment methods and procedures shall be specified by the department to establish whole-effluent toxicity limitations that are consistent with paragraph (c)(2)(D)(i) of this regulation. (K.A.R. 28-16-28e(c)(2)(D)(iii).

Designated Uses: All streams in the watershed are designated for Expected Aquatic Life. All other designated uses are detailed in Table 1. All designated uses for all segments under this TSS TMDL will be maintained or achieved with this TMDL.

Table 1. Designated Uses for streams within the Little Arkansas Watershed.

Stream	Segment #	Contact Recreation	Drinking Water Supply	Food Procurement	Groundwater Recharge	Industrial Use	Irrigation Use	Livestock Use
Turkey Cr	11	Primary C	No	No	Yes	No	Yes	Yes
Turkey Cr	12	Secondary b	No	No	No	No	Yes	Yes
Dry Turkey Cr	13	Primary B	Yes	Yes	Yes	Yes	Yes	Yes
Running Turkey	25	Secondary b	Yes	No	Yes	Yes	Yes	Yes
Bull Cr	24	Primary C	Yes	No	Yes	Yes	Yes	Yes
Little Ark R	10	Primary C	Yes	Yes	Yes	Yes	Yes	Yes
Little Ark R	14	Primary B	Yes	Yes	Yes	Yes	Yes	Yes
Sand Cr	23	Primary C	No	No	Yes	No	Yes	Yes
Lone Tree Cr	20	Secondary b	No	Yes	Yes	No	Yes	Yes
Dry Cr	22	Secondary b	No	No	Yes	No	No	Yes
Salt Cr	21	Secondary b	No	No	No	No	No	No
Horse Cr	19	Secondary b	Yes	No	Yes	Yes	Yes	Yes
Black Kettle Cr	368	Primary B	Yes	No	Yes	Yes	Yes	Yes
Kisiwa Cr	15	Secondary b	Yes	Yes	Yes	Yes	Yes	Yes
Little Ark R	1	Primary B	Yes	Yes	Yes	Yes	Yes	Yes
Jester Cr	2	Primary C	Yes	Yes	Yes	Yes	Yes	Yes
Gooseberry Cr	17	Secondary b	No	Yes	No	Yes	No	No
W. Fk. Jester Cr	18	Primary C	No	Yes	No	No	No	Yes
Little Ark R	3	Primary C	Yes	Yes	Yes	Yes	Yes	Yes
Little Ark R	5	Primary C	Yes	Yes	Yes	Yes	Yes	Yes
Little Ark R	9	Primary C	Yes	Yes	Yes	Yes	Yes	Yes
Middle Fk Chisholm Cr	817	Secondary b	No	Yes	No	No	Yes	Yes
Chisholm Cr	1693	Secondary a	Yes	Yes	Yes	Yes	Yes	Yes

2. CURRENT WATER QUALITY CONDITION AND DESIRED ENDPOINT

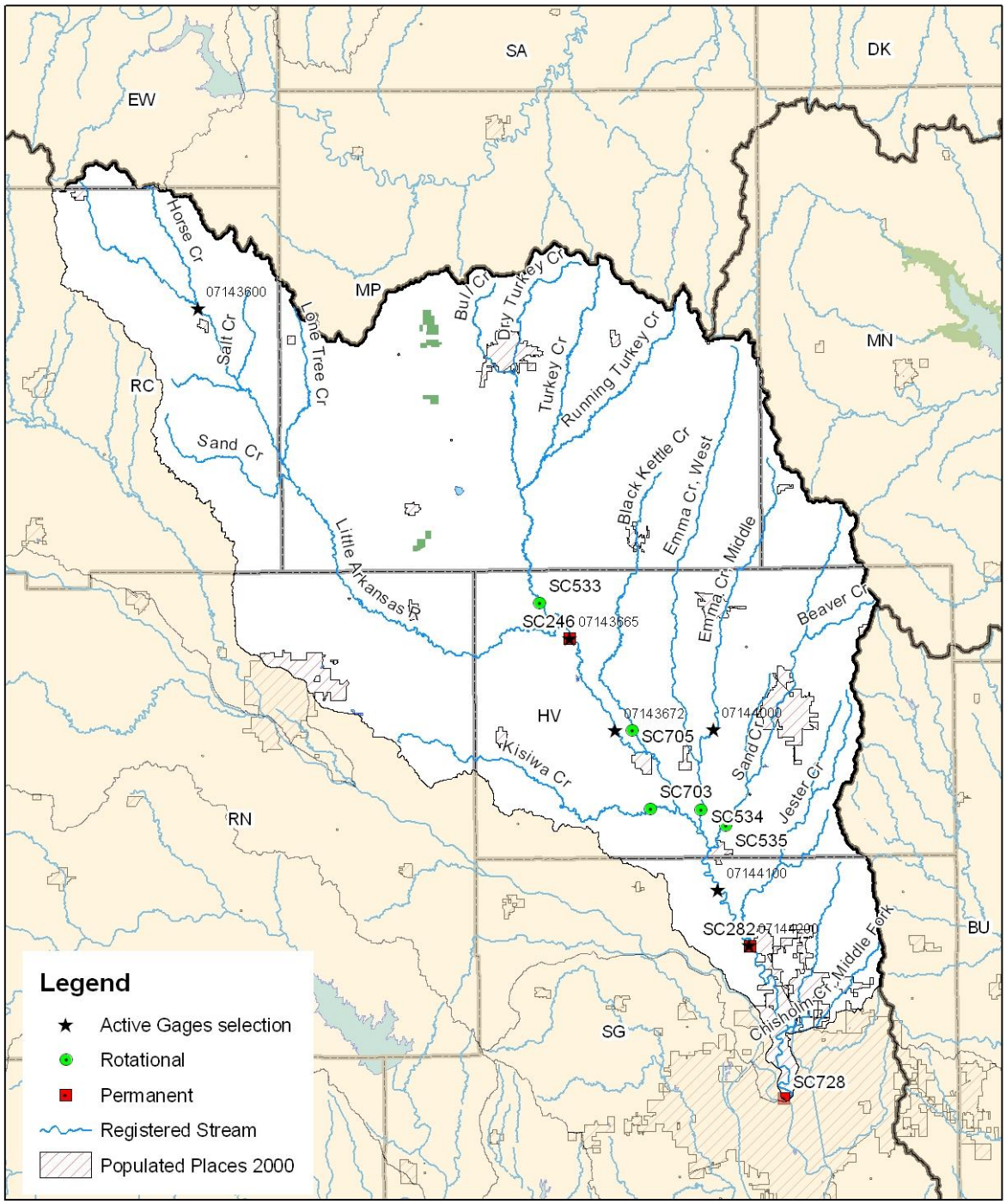
Level of Support for Designated Uses under 2012 303(d): The median TSS value for the impaired stations within the watershed are above the threshold value (50 mg/L) listed in the 2012 303(d) methodology, suggesting that the river is not likely to support a rich diversity of aquatic life.

Stream Monitoring Sites and Period of Record: KDHE Rotational Stations SC533 (Turkey Creek), SC534 (Emma Creek), and SC535 (Sand Creek) sampled bimonthly or quarterly during 1990, 1994, 1998, 2002, 2006, and 2010. KDHE Rotational Station SC703 (Kisiwa Creek) sampled bimonthly or quarterly during 1994, 1998, 2002, 2006, and 2010. KDHE Rotational Station SC705 (Black Kettle Creek) sampled bimonthly or quarterly during 1995, 1999, 2003,

2006, and 2010. KDHE Permanent Stations SC246 (Little Ark R at Alta Mills) and SC282 (Little Ark R at Valley Center) sampled bimonthly or quarterly from 1990-2011. KDHE Permanent Station SC728 (Little Ark R at Wichita) sampled bimonthly or quarterly from 2000-2011. KDHE Biology sampling site SB282 (Little Ark R at Valley Center) sampled annually from 1990-2011, with the exception of 2002, 2004, or 2008 when no samples were collected.

Supplementing the routine KDHE sampling, the Little Arkansas Watershed Restoration and Protection Strategy (WRAPS) group has sampled throughout the watershed from 2008-2010. This sampling was conducted by Kansas State University.

Figure 1. Little Arkansas River Watershed Base map.



Flow Record: The estimated long-term flow conditions were calculated from USGS gaging station 07143665 (1990-2011) on the Little Arkansas River at Alta Mills and USGS gaging station 07144200 (1990-2011) on the Little Arkansas River at Valley Center. Gage 07143665 is located at the same location of KDHE sampling station SC246 and gage station 07144200 is located at the same location as SC282. Long-term flow conditions for Turkey Creek were estimated based on the drainage area ratios between SC533 and USGS gage 07143665 on the Little Arkansas River at Alta Mills. Long-term flow conditions for Black Kettle Creek (SC705), Kisiwa Creek (SC703), Emma Creek (SC534), Sand Creek (SC535) and the Little Arkansas R at Wichita (SC728) were based on the drainage area ratio between the respective tributary and USGS gage 07144200 on the Little Arkansas River at Valley Center. Long Term Flow estimates for the main stem segments in the watershed are summarized in Table 2.

Table 2. Long Term Flow Conditions in the Little Arkansas Watershed as calculated from USGS Gages 07143665 and 07144200 and the respective drainage areas.

Station	Stream	Drainage Area (Miles^2)	Mean Flow (cfs)	Percent of Flow Exceedance				
				90% (cfs)	75% (cfs)	50% (cfs)	25% (cfs)	10% (cfs)
SC533	Turkey Cr	194	53.7	0.98	2.27	4.74	14.23	71.0
SC246	Little Ark R at Alta Mills	736	204	3.7	8.6	18.0	54.0	269.4
SC705	Black Kettle Cr	77	23	1.0	2.2	3.9	8.9	38.1
SC703	Kisiwa Cr	119	35	1.6	3.4	6.0	13.8	58.8
SC534	Emma Cr	175	52	2.4	5.0	8.8	20.3	86.5
SC535	Sand Cr	104	31	1.4	3.0	5.3	12.1	51.4
SC282	Little Ark R. at Valley Center	1327	392	18.0	38.0	67	154	655.8
SC728	Little Ark R. at Wichita	1404	414	19.0	40.2	70.9	162.9	693.9

Flow durations curves over the period of record from 1990-2011 are illustrated for the USGS Gages in Figure 2. Annual flow averages and peak flows are detailed in Figures 3a and 3b respectively. Extremely dry years were observed in 1990, 1991, 1994, 2006, and 2011. Years with flows higher than average flows at both gages indicate wetter years, which include the years of 1993, 1995, 1998, 1999, 2001, 2007, and 2009. Annual peak flows were the greatest during 1993, 1995, 1998 and 2000 for the gage at Alta Mills. Peak flows at the Valley Center gage were the highest during 1993, 1998, 2001, 2004, and 2010. Throughout the year on the Little Arkansas River, streamflow averages are the highest during May, June and July as observed in Figure 4.

Figure 2. Flow duration at USGS gages 07143665 and 07144200 on the Little Arkansas River.

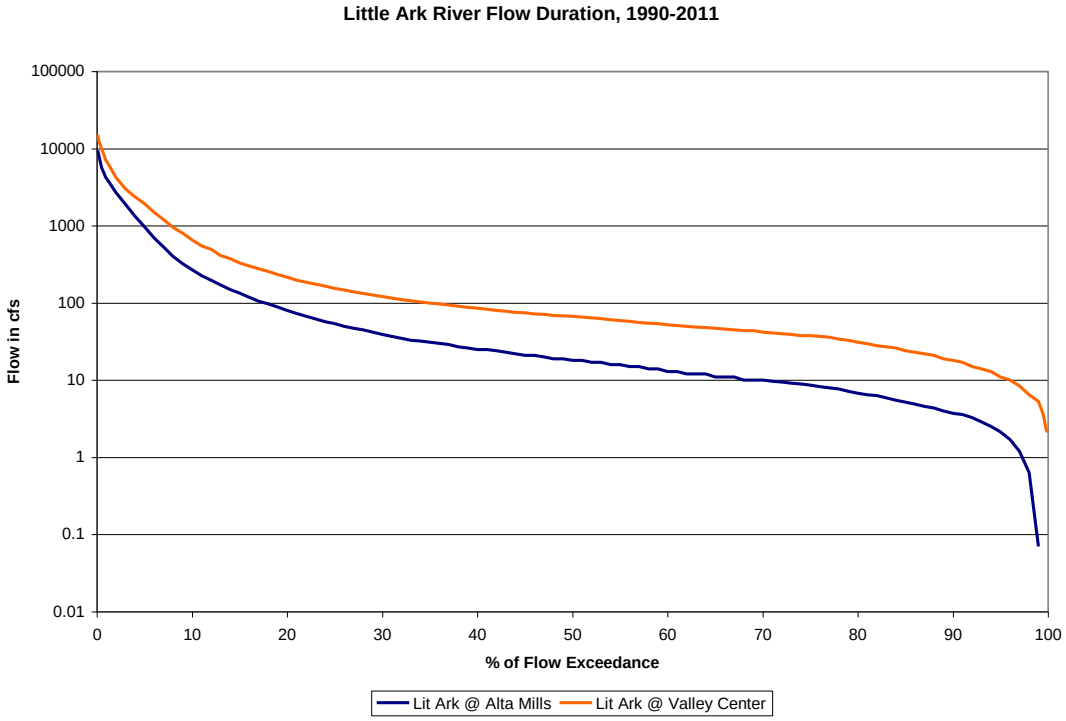


Figure 3a. Annual average flow values for USGS gages 07143665 and 07144200 on the Little Arkansas River.

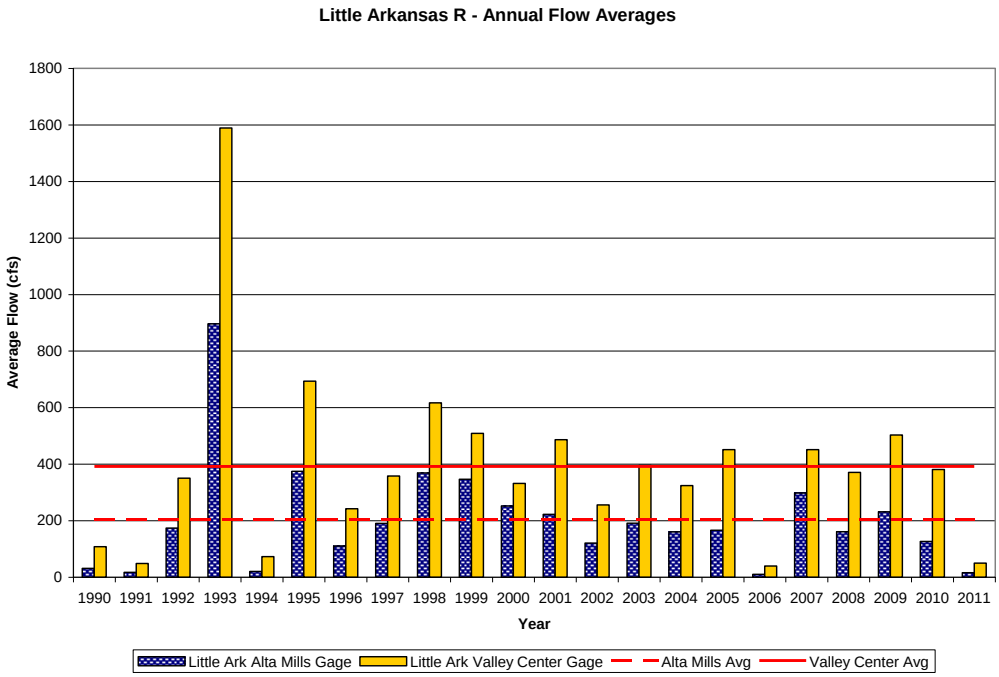


Figure 3b. Peak annual flows on the Little Arkansas River at USGS Gages 07143665 and 07144200.

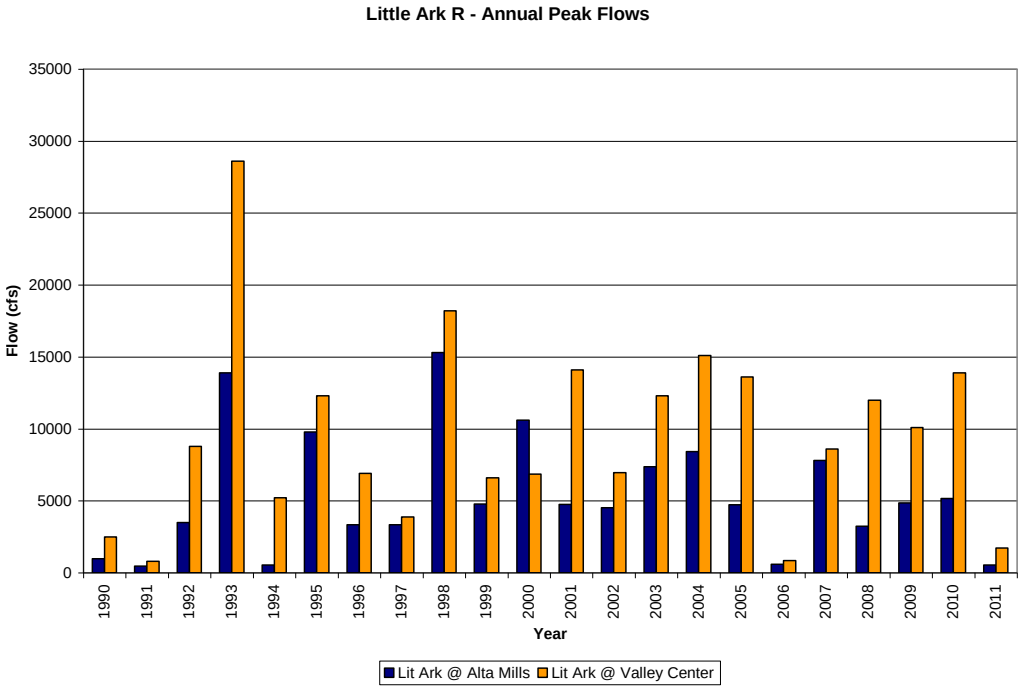
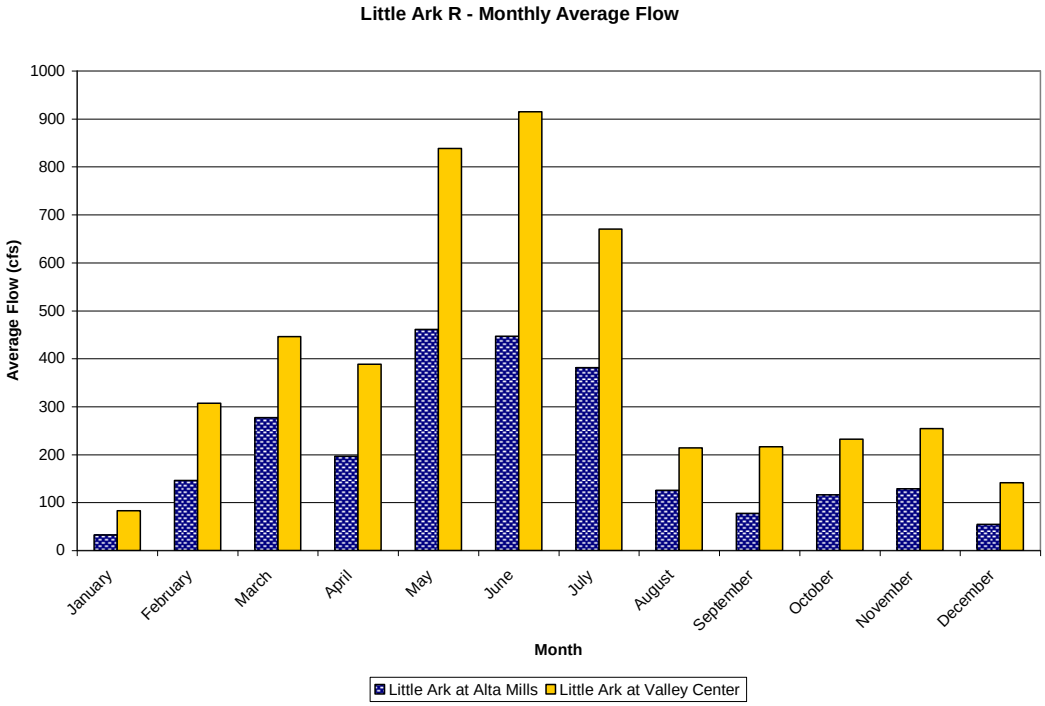


Figure 4. Average Monthly flow at USGS gages 07143665 and 07144200.



Current Conditions: Total Suspended Solids (TSS) is an important indicator typically linked to erosion, siltation, and nutrient transport in aquatic systems (USEPA, 2006). Excess TSS has considerable effects on invertebrate and fish communities and water quality in lakes and streams. Siltation is the leading cause for diminishing aquatic life in stream systems (KDHE, 2006). In 1972, the U.S. EPA approved the numeric TSS standards from the European Inland Fisheries Advisory Commission, and later updated them in 1982 (Doisy and Rabeni, 2004). These values are used as a guideline and listed as follows:

< 25 mg/L	- No harmful effects on fisheries or high level of protection
25-80 mg/L	- Maintain good or moderate fisheries or moderate level of protection
80-400 mg/L	- Unlikely to support good freshwater fisheries or low level of protection
> 400 mg/L	- Support only poor fisheries or very low level of protection

KDHE analyzed 15 years of suspended solids data and associated biological monitoring data. A strong threshold relationship exists at 50 mg/L median TSS, above which streams are unlikely to support a rich diversity of aquatic life. Species richness is strongly correlated with other measures of aquatic life use support, including proportion of ephemeroptera, plecoptera, and trichoptera species, a long-used indicator of acceptable biological condition in Kansas waters (KDHE, 2010).

The mean, median, 90th percentile and upper quartile (75th percentile) TSS concentrations for the KDHE sampling stations within the Little Arkansas watershed are detailed in Table 3. Because of the large variability in ambient suspended solids concentrations, median values are appropriate for determining long-term conditions. The highest median concentrations within the watershed are associated with Turkey Creek, Black Kettle Creek, and Kisiwa Creek. The sampling datasets for Black Kettle Creek and Kisiwa Creek are small and likely biased towards higher flow conditions. The permanent sampling stations along the Little Arkansas River provide larger data sets, which capture a better representation of conditions over all flow conditions. Sampling data for the sampling sites were categorized for each of the three defined seasons: Spring (April-June), Summer-Fall (July-October), and Winter (November-March). Seasonal concentration averages are illustrated in Table 4. Figure 5 details boxplots of the data sets associated with the stations on the Little Arkansas River seasonally. A summary of the TSS data for the rotational stations is detailed in Figure 6. TSS concentrations are the highest during the Spring season for stations on the Little Arkansas River and highest during the Summer-Fall season for the tributary stations, likely reflecting thunderstorm events sampled in the summer.

Table 3. Summary of TSS concentrations in the Little Arkansas Watershed.

Station	Stream	Number of Samples (n)	90th Percentile Concentration (mg/L)	75th Percentile Concentration (mg/L)	Average Concentration (mg/L)	Median Concentration (mg/L)
SC533	Turkey Cr	33	214	136	103	84
SC246	Little Ark R at Alta Mills	119	299	125	159	54
SC705	Black Kettle Cr	13	618	392	236	82
SC703	Kisiwa Cr	7	149	114	89	66
SC534	Emma Cr	30	103	72	63	38
SC535	Sand Cr	33	95	72	49	40
SC282	Little Ark R. at Valley Center	120	309	118	117	51
SC728	Little Ark R. above confluence with Ark R.	60	281	111	110	57

Table 4. Little Ark Watershed Seasonal Average Concentrations:

Station	Stream	Spring TSS Avg (mg/L)	Summer-Fall TSS Avg. (mg/L)	Winter TSS Avg. (mg/L)
SC533	Turkey Cr	128	160	45
SC246	Little Ark R at Alta Mills	228	199	84
SC705	Black Kettle Cr	123	211	402
SC703	Kisiwa Cr	98	119	46
SC534	Emma Cr	73	111	24
SC535	Sand Cr	65	64	28
SC282	Little Ark R. at Valley Center	193	119	68
SC728	Little Ark R. at Wichita	135	132	75

Figure 5. Little Arkansas River TSS Concentrations (1990-2011).

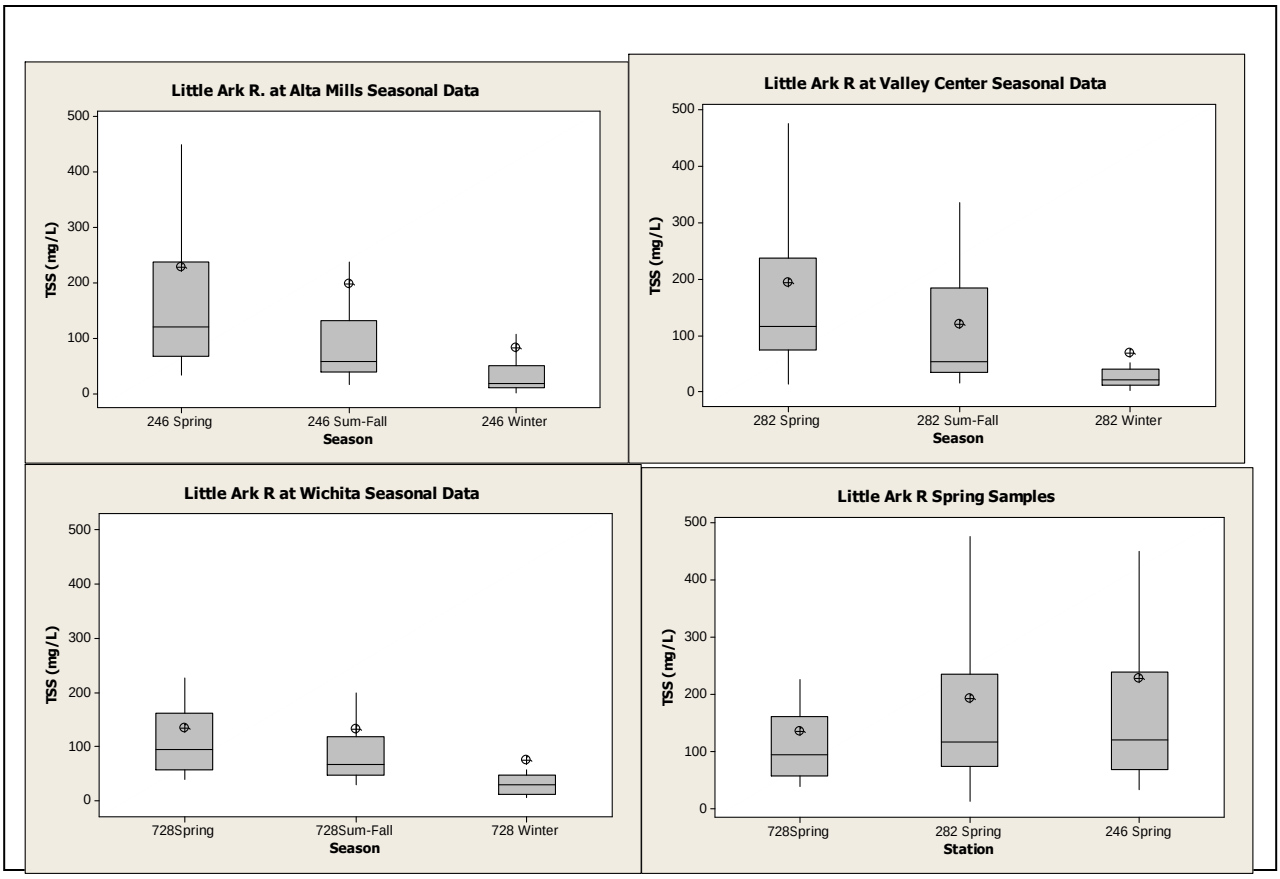
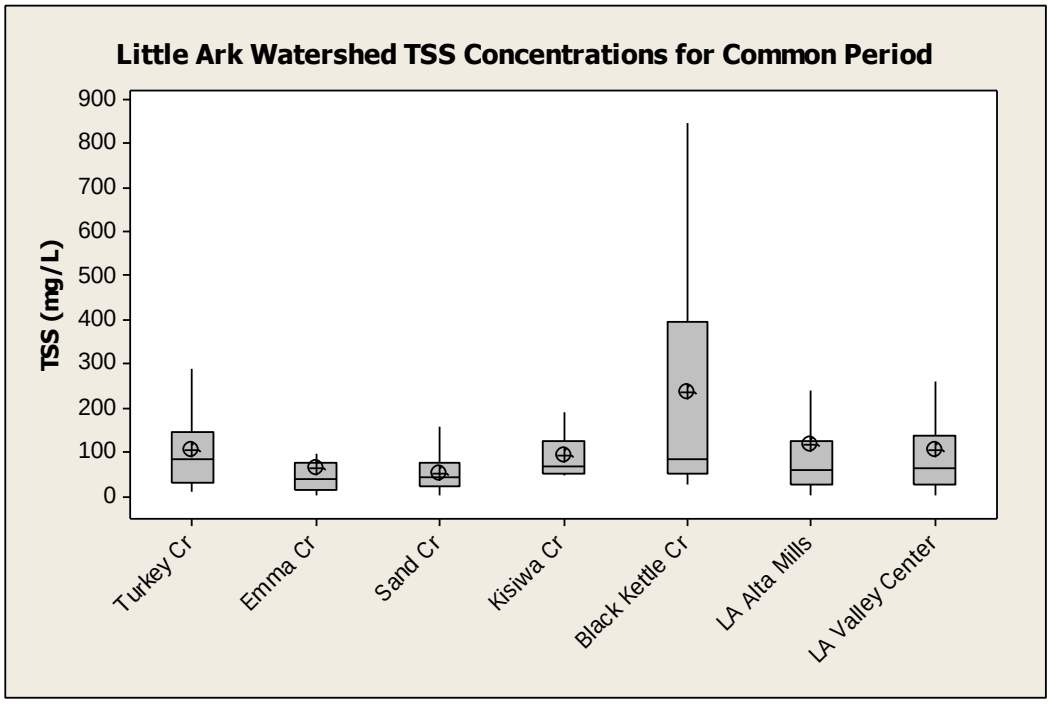


Figure 6. Little Arkansas Watershed TSS Concentrations (1990-2011).



Since loading capacity varies as a function of the flow present in the stream, this TMDL represents a continuum of desired loads over all flow conditions, rather than fixed at a single value. High flows and runoff equate to lower flow durations; baseflow influences generally occur in the 75-100% exceeded flow range while the effect of point sources primarily occur in the 95-100% exceeded flow range. TSS concentrations on the Little Arkansas River relative to flow are detailed in Table 5.

Table 5. Seasonal TSS average concentrations (mg/L) relative to flow conditions.

Station	% of Flow Exceedance	Spring TSS Avg (mg/L)	Summer Fall TSS Avg (mg/L)	Winter TSS Avg (mg/L)
SC246	0-10%	579	717	673
	11-25%	185	832	106
	26-75%	123	82	20
	76-100%	111	61	34
SC282	0-10%	461	576	407
	11-25%	139	177	135
	26-75%	119	89	23
	76-100%	62	50	23
SC728	0-10%	224	720	310
	11-25%	125	188	222
	26-75%	103	127	24
	76-100%	47	60	17

The KDHE Stream Biological Monitoring Program samples SB282 on the Little Arkansas River at Valley Center on an annual basis, which is located at the same location as the stream chemistry site SC282. Analysis of the Macroinvertebrate Biotic Index (MBI) and the percent of Ephemeroptera, Plecoptera, and Trichoptera (EPT) determined which sampling years were indicative of full support for aquatic life. As seen in Table 6, the years of 1990, 1993, 1997, 1999, 2003, 2005, 2007, and 2009 the Little Arkansas River at Valley Center fully supported aquatic life for both the MBI and EPT%. TSS samples from SC282 were analyzed and compared between these years with full biological support for both MBI and EPT% and the years that did not achieve full support for both indexes. Figure 7 and 8 details the comparison of the TSS values between these two sample groups based on the flow condition. TSS values are much lower during the normal flow conditions during the years when the biology indices were fully supporting aquactic life. TSS concentrations during the high flow conditions are slightly lower during these same years and there is relatively no difference in the concentrations during the low flows between the comparative sampling sets.

Table 6. Biotic Indices at SB282 on Little Arkansas River at Valley Center. Green shade indicates full support, yellow indicates partial support, and pink shade indicates non-support. TSS averages are for the sampling year.

Site	Sampling Date	Sampling Year	MBI	EPT %	TSS Avg. (mg/L)	Avg Flow on Sampling Dates (cfs)
SB282	19900503	1990	4.37	52	104	73.2
SB282	19910807	1991	4.55	34	98	23
SB282	19920424	1992	4.89	29	43	31
SB282	19930917	1993	4.29	72	66	314
SB282	19940811	1994	4.52	55	63	47
SB282	19950928	1995	4.71	56	118	1368
SB282	19960424	1996	5.34	32	177	527
SB282	19970805	1997	4.23	62	62	107
SB282	19980909	1998	4.84	41	169	1849
SB282	19991013	1999	4.28	64	89	124
SB282	20000920	2000	4.54	42	64	114
SB282	20010913	2001	5.05	33	191	1831
SB282	20030708	2003	4.25	73	326	554
SB282	20050721	2005	4.37	74	127	1073
SB282	20060621	2006	4.82	47	55	24
SB282	20070828	2007	4.28	71	77	156
SB282	20090811	2009	4.23	60	76	211
SB282	20100413	2010	5.43	30	115	93
SB282	20110607	2011	4.59	49	27	16
		Full Support	≤ 4.5	≥ 48%		
		Partial Suppo	4.51-5.39	31-47%		
		Non-Support	≥ 5.4	≤ 30%		

Figure 7. TSS Concentration averages between the TSS samples at SC282 during the sampling years with full biological support for MBI and %EPT and the years without full support relative to flow condition.

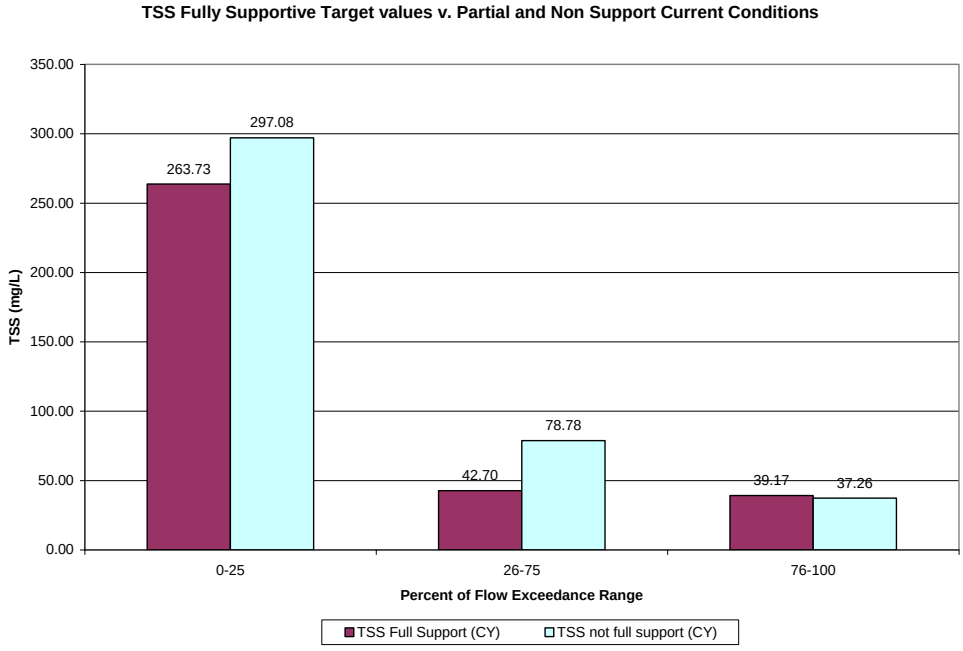
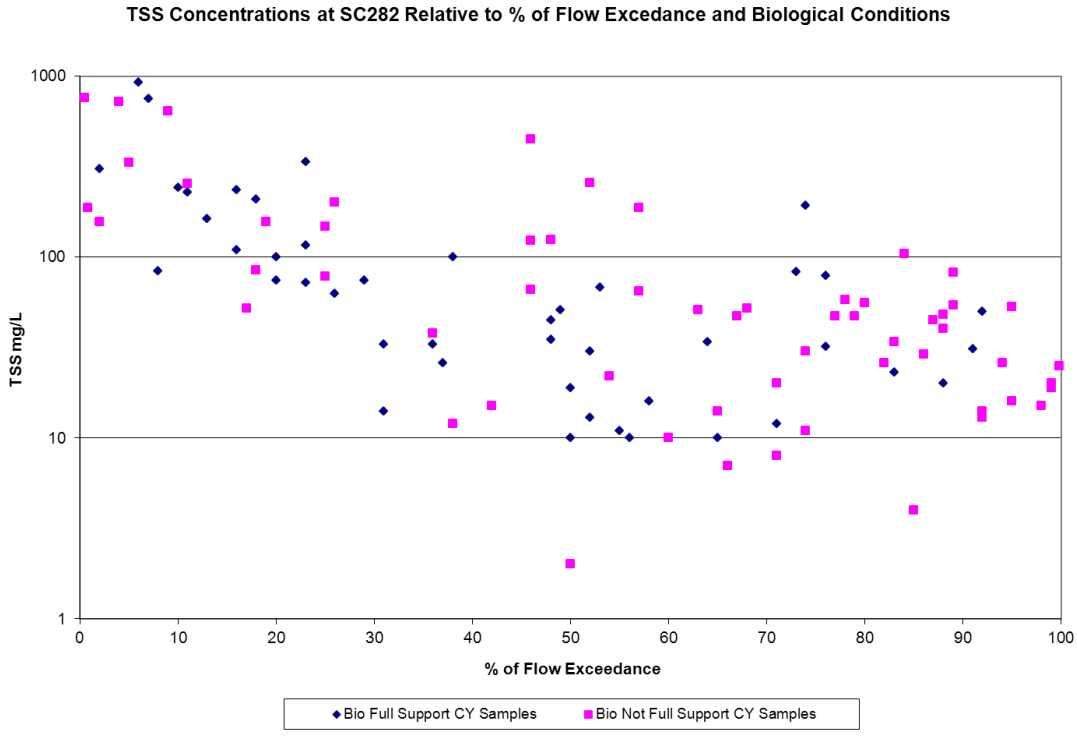


Figure 8. TSS Concentrations for the TSS samples at SC282 during the sampling years with full biological support for MBI and %EPT and the years without full support relative to the percent of flow exceedance.



A load curve was established for the TSS target values based on the sampling years where full biological support was achieved at SB282. A cubic regression between the TSS samples collected during the years of full support and the respective percent of flow exceedance for these samples was computed (see Appendix B) to define the TSS target concentrations to meet the narrative suspended solids Water Quality Criteria within the watershed. The resulting concentrations calculated through the cubic regression were modified by averaging the calculated concentrations for the normal and low flow conditions since there was little variation during these flow conditions. The established TSS concentration targets apply to each station within the watershed and were utilized to compute load targets within the watershed, as seen in Figures 9, 10, and 11. The load curves represent the TSS target loads since any point along the curve represents the appropriate water quality to ensure the narrative water quality standard is being achieved at respective flows. Historic excursions from the established TSS load targets are seen as plotted points above the established load curve. Therefore, the points plotting below the applicable load duration curve are definitively not likely to show impacts from excessive TSS, consistent with the narrative criterion for aquatic life.

Figure 9. Seasonal TSS loads at SC246 relative to percent of flow exceedance.

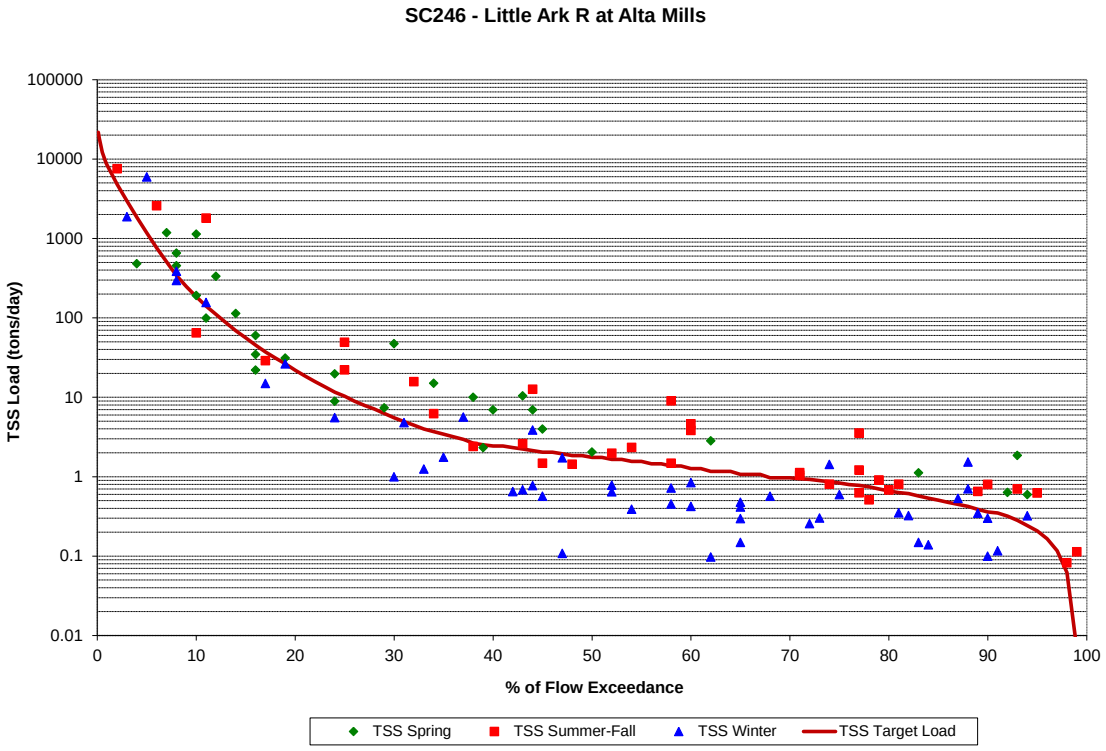


Figure 10. Seasonal TSS loads at SC282 relative to percent of flow exceedance.

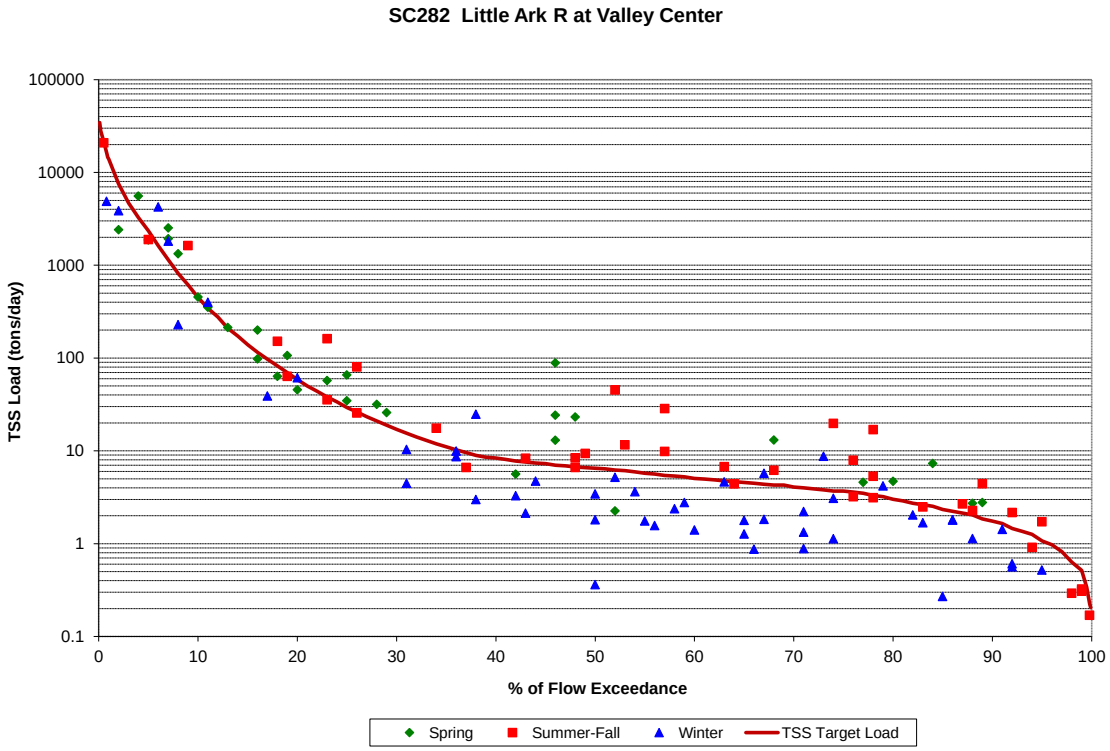
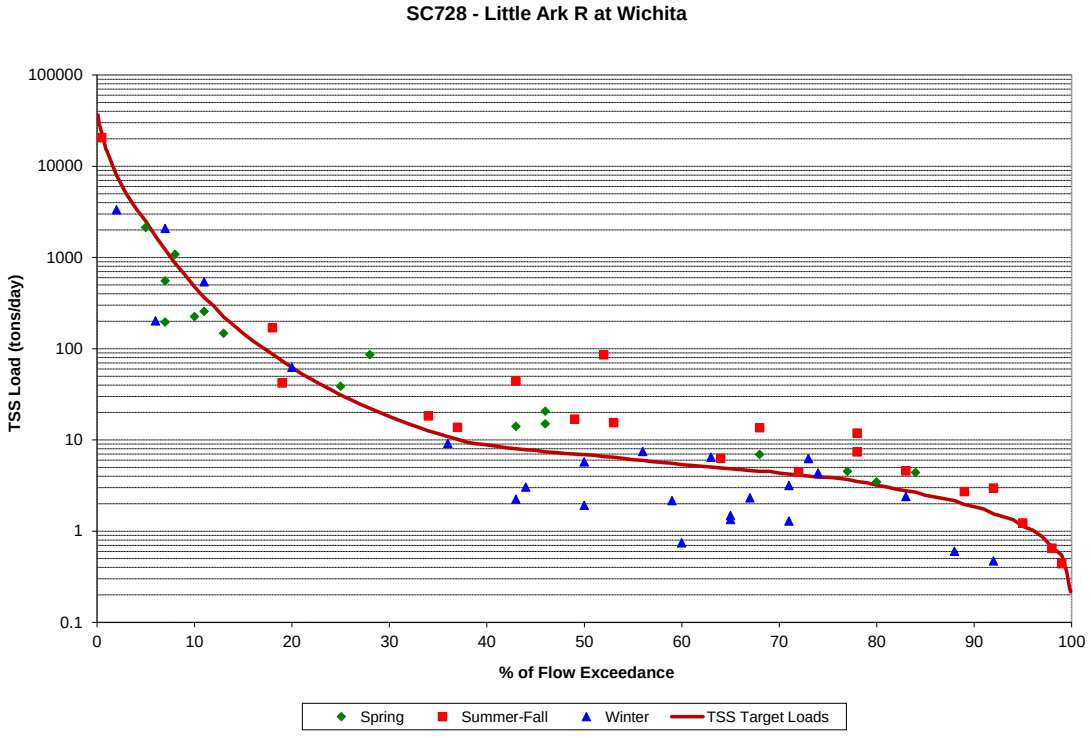
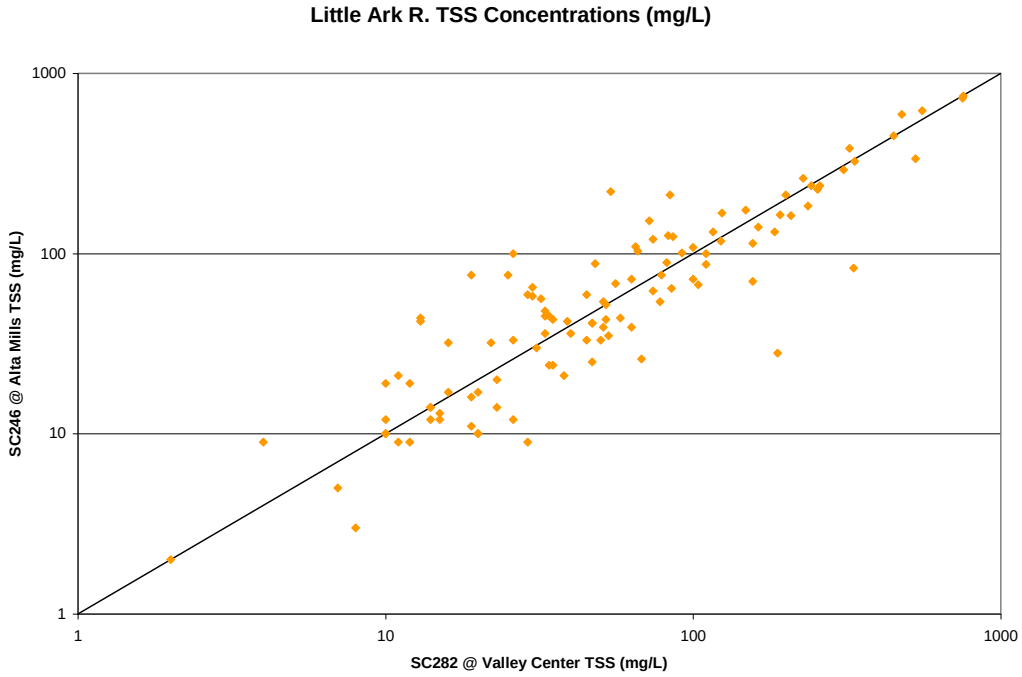


Figure 11. Seasonal TSS loads at SC728 relative to percent of flow exceedance.



The permanent KDHE sampling stations along the Little Arkansas River were typically sampled on the same sampling date over the period of record. Common samples from stations SC246 (Alta Mill) and SC282 (Valley Center) are graphed in Figure 12. Higher TSS concentrations are often observed at the upstream station at Alta Mills, indicating Turkey Creek influences concentrations observed at this station. The influence of clean fresh water from the Equus Beds aquifer below Alta Mills likely lowers the TSS concentrations seen at Valley Center.

Figure 12. Comparison between samples at SC246 and SC282 for samples obtained on common sampling dates.



Common samples between the permanent stations on the Little Arkansas River and the rotational stations are plotted and compared in Figures 13 and 14. As seen in Figure 13, Turkey Creek consistently has higher TSS concentrations than the downstream permanent station on the Little Arkansas River at Alta Mills (SC246). The TSS concentrations originating from Turkey Creek are diluted when they reach the main stem of the Little Arkansas River. TSS concentrations on the Little Arkansas River at Valley Center (SC282) are consistently higher than the tributaries of Emma Creek, Sand Creek, and Kisiwa Creek for the common samples collected on the same sampling date. The small number of samples obtained from the stations on Black Kettle Creek and Kisiwa Creek make it difficult to determine the influence of these tributaries on the TSS loads observed at the Little Arkansas station at Valley Center. However, based on the supplemental WRAPS data these tributaries are likely not influencing the TSS load as much as Turkey Creek.

Figure 13. Common TSS sample concentrations between Turkey Creek and Little Arkansas River at Alta Mills.

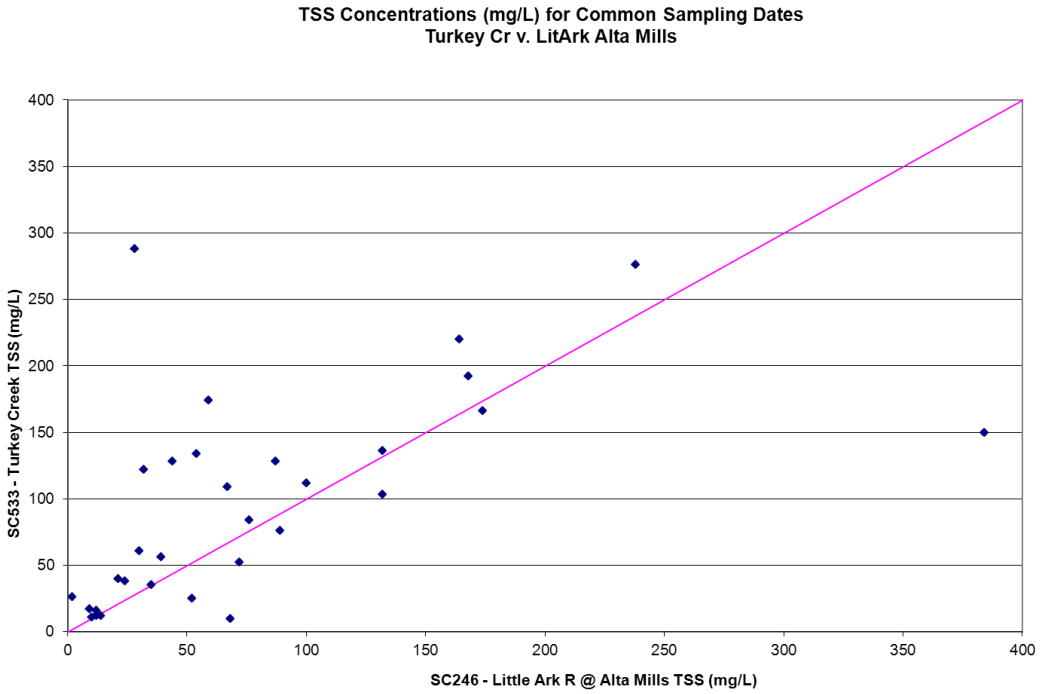


Figure 14. Common TSS sample concentrations between tributary stations and SC282 on the Little Arkansas River at Valley Center.

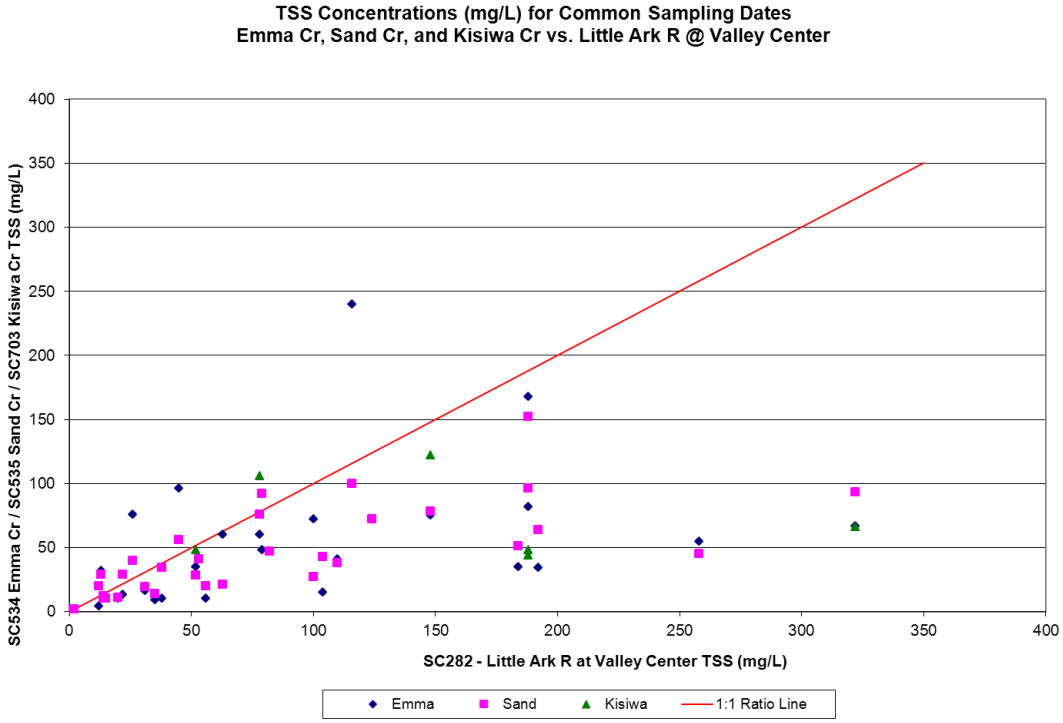
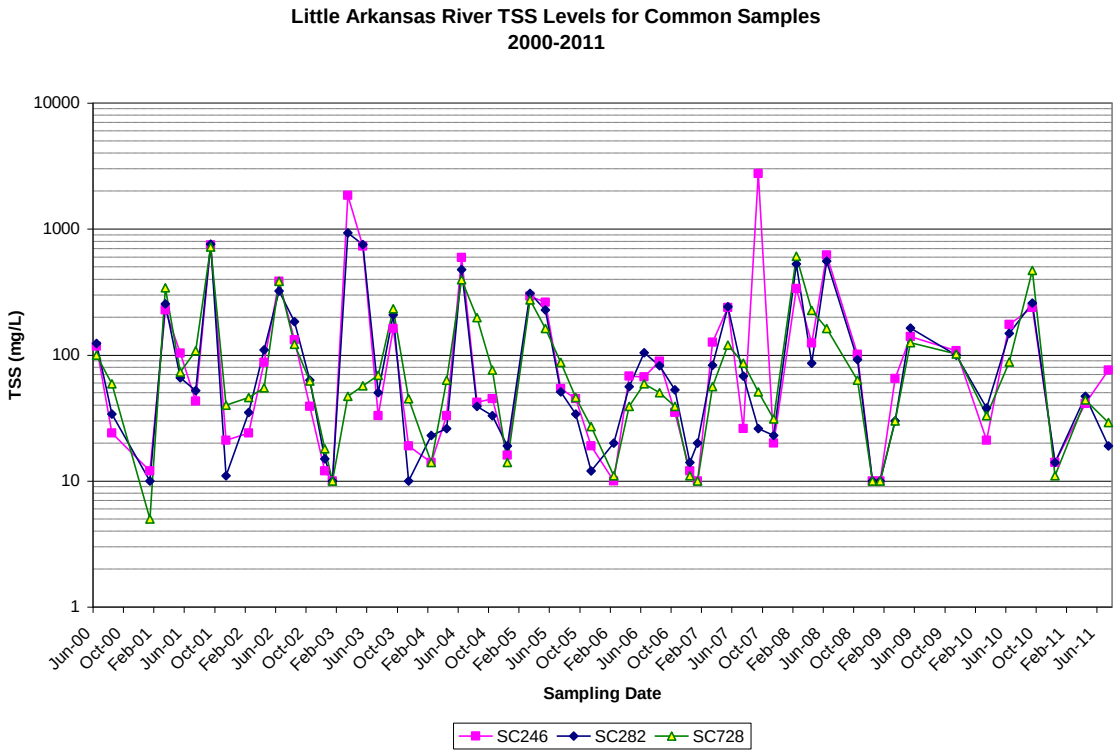


Figure 15 illustrates the TSS concentrations associated with common sampling dates from the three stations on the Little Arkansas River over the period of record from 2000-2011. Generally, TSS concentrations are similar at all three sampling stations throughout with a few exceptions that are influenced by runoff events based on the USGS flow data. Based on the Mann-Whitney and Kruskall-Wallis statistical tests, there are no significant differences in the concentrations between these three sampling stations. This indicates that loads are only increasing in the lower portion of the watershed in proportion with the increase in flow and that TSS loads above SC246 at Alta Mills contribute to the impairment on the lower reaches of the Little Arkansas River.

Figure 15. TSS concentrations for common sampling dates on the Little Arkansas River at SC246, SC282, and SC728.



A mass balance scenario was established for the Little Arkansas River watershed to estimate the TSS loading contribution from each monitored station within the watershed. The scenario is based on average TSS concentrations at the respective KDHE sampling stations utilizing the 25th percentile flow exceedance value. Based on the mass balance scenario, as seen in Table 7, 40% of the observed TSS load at Wichita is attributed to loads derived from above Alta Mills. That contribution is further distributed as 8% of the load above Alta Mills is coming from Turkey Creek and 32% of the load is attributed to the area above the confluence with Turkey Creek.

Table 7. TSS Mass Balance Loading Scenario based on average TSS concentrations.

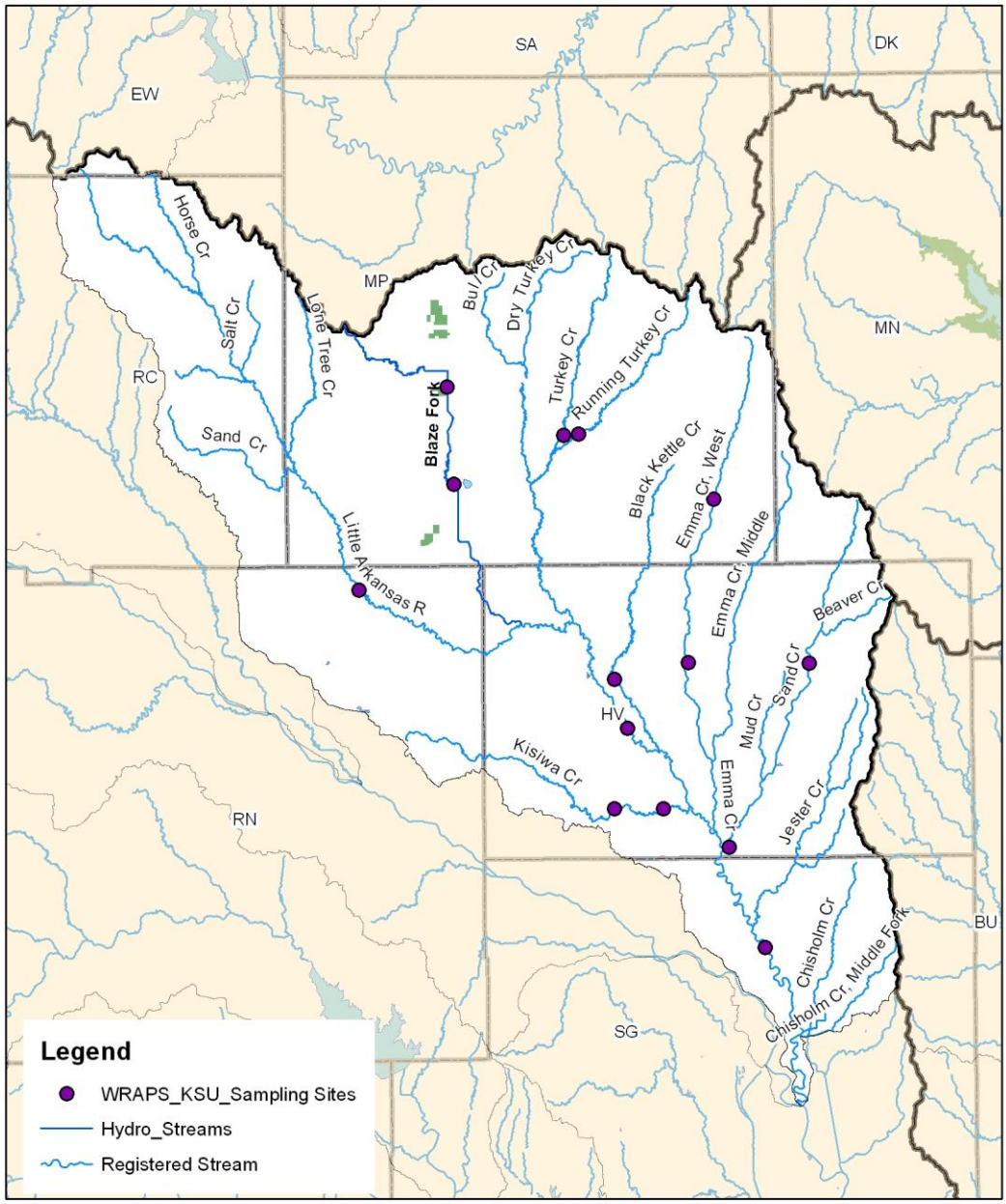
Stream	Station	TSS (mg/L)	Flow %	Flow (cfs)	Load (tons/day)	Contributing Load (tons/day)	Observed at Wichita
Turkey	SC533	103	25	14.23	3.96	3.96	8.17
Lit Ark Alta Mills	SC246	159	25	54	23.18	19.22	39.71
Black Kettle	SC705	236	25	8.9	5.67	5.67	11.71
Kisiwa Cr	SC703	89	25	13.8	3.32	3.32	6.85
Emma Cr	SC534	63	25	20.3	3.45	3.45	7.13
Sand Cr	SC535	49	25	12.1	1.60	1.60	3.31
Lit Ark Valley	SC282	117	25	154	48.65	11.43	23.60
Lit Ark Wichita	SC728	110	25	163	48.41	-0.24	-0.49
L Ark Wichita Balance	SC728	110	25	163	48.41	48.41	100.00

The Little Arkansas Watershed Restoration and Protection Strategy Group (WRAPS) utilized Kansas State University to collect intensive water quality data at various locations throughout the watershed from 2008-2010. A summary of the TSS concentration averages for each sampling year and the overall median concentrations for these sampling events are detailed in Table 8. The WRAPS sampling locations are detailed in Figure 16. Sampling results for the WRAPS yielded median TSS concentrations at 50 mg/L or above at Lower Blazefork Creek, Lower West Emma Creek, Lower Sand Creek, and all sampling sites on the Little Arkansas River. According to this data TSS loading is greatest on the main stem of the Little Arkansas River, with appreciable loading being attributed to the Blazefork Creek, Emma Creek, and Sand Creek watersheds. The supplemental data assists the WRAPS group for targeting and evaluating BMP implementation activities. Success of this TMDL will be evaluated based on KDHE data.

Table 8. Summary of WRAPS and KSU TSS Data (2008-2010).

Sampling Location	2008 TSS Avg. (mg/L)	2009 TSS Avg. (mg/L)	2010 TSS Avg. (mg/L)	2008-2010 Avg. (mg/L)	2008-2010 Median
Little Ark R, Hwy 61	108	132	93	110	54
Little Ark R, Hwy 50	136	227	86	147	68
Little Ark R, Valley Center	168	400	103	218	97
Upper Blazefork Cr	57	137	139	109	31
Lower Blazefork Cr	80	227	52	116	57
Turkey Cr	55	29	27	38	16
Running Turkey Cr	82	32	27	48	21
Black Kettle Cr	52	65	11	42	8
Upper West Emma Cr	73	41	36	51	35
Lower West Emma Cr	90	67	58	72	58
Upper Kisiwa Cr	59	56	40	52	19
Lower Kisiwa Cr	65	177	35	90	34
Upper Sand Cr	52	43	50	49	29
Lower Sand Cr	81	95	60	78	50

Figure 16. WRAPS/KSU sampling points in the Little Arkansas River watershed.



Desired Endpoint: The ultimate endpoint of the TMDL will be to achieve the Kansas Water Quality Standards by eliminating any of the impacts to aquatic life associated with excessive suspended solids as described in the narrative criteria pertaining to solids. All designated uses for all segments will be maintained or achieved with this TMDL. There are no existing numeric sediment criteria currently in Kansas. However, the listing methodology for TSS in the 2008

and 2010 Section 303(d) lists showed some relationship between robust macroinvertebrate communities, as indicated by good MBI scores and median TSS values for streams where both biological and chemical sampling occurred. The breakpoint between good biotic quality and indications of impairment was in the vicinity of 50 mg/L. The endpoint for this TMDL is more conservative and based on the TSS values during the years where the MBI and %EPT biological indices were fully supporting aquatic life. The TMDL is based on a cubic regression and details TSS concentrations and loads under all flow conditions. Table 9 details the TMDL concentrations at various flow conditions throughout the watershed. The narrative criterion will be successfully met with the utilization of the numeric TMDL targets. Current median concentrations within the watershed as compared to the endpoint at the median flow condition are illustrated in Figure 17.

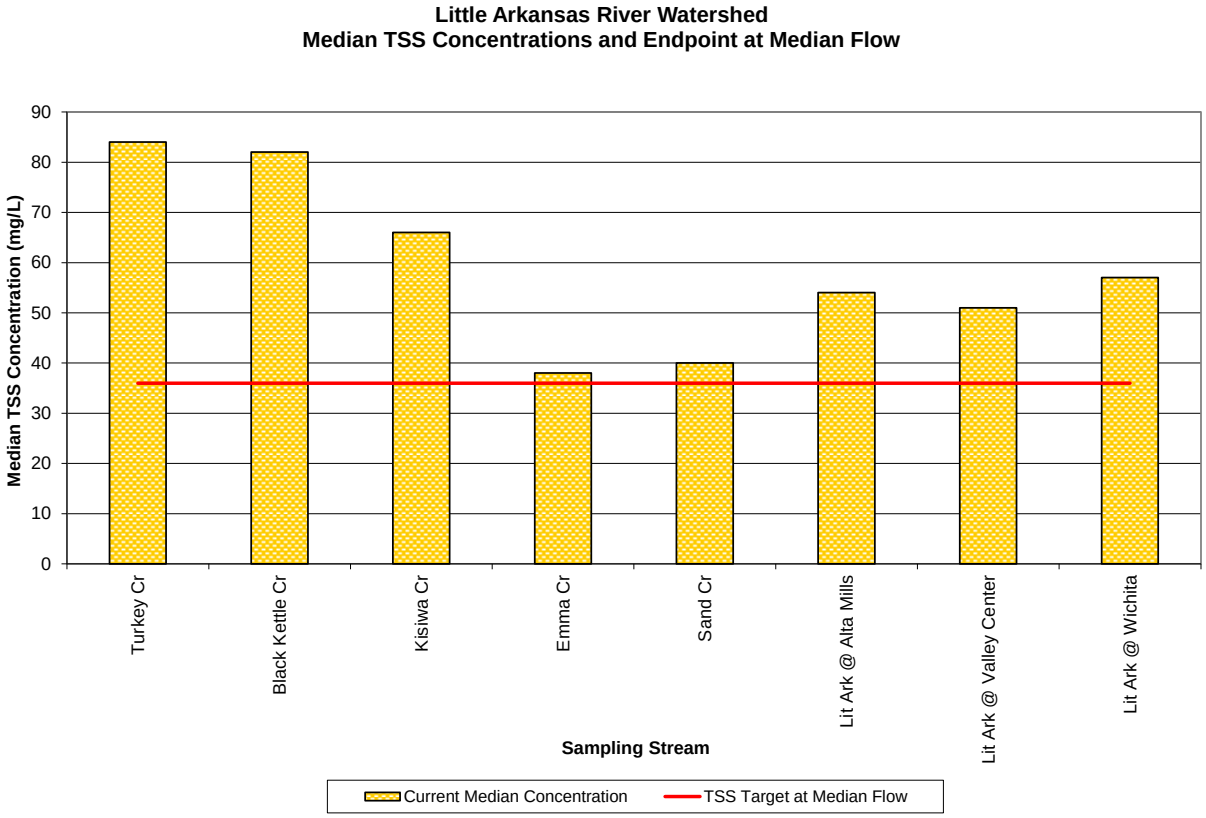
Upon attainment of the initial endpoint, an assessment of stream conditions will be done to corroborate the reduction of the nuisance conditions expressed in the narrative criteria. Adjustments to the follow-up endpoint linked to the resulting stream conditions may be made after that assessment. At such time that stream conditions mirror those expressed by the narrative criteria, the resulting ambient TSS concentrations will be adopted as numeric criteria. Achievement of these endpoints indicates any loads of suspended solids are within the loading capacity of the stream, water quality standards are attained and full support of the designated uses of the stream has been restored. Therefore, the ultimate endpoint indicating full biological support is achieved will be the MBI index $\leq$ 4.5 and the EPT% is $\geq$ 48%.

The critical conditions for TSS load generally occur during higher flow conditions during all seasons. The TSS concentrations are the highest during the spring and summer-fall season. The high flow and low flow conditions are critical conditions the effects aquatic life. Critical conditions and seasonality are accounted for in this TMDL since the TSS TMDL applies to all flow conditions throughout the year.

Table 9. TSS TMDL Concentrations for Little Arkansas River watershed covered under this TMDL.

% of Flow Exceedance	TSS TMDL Concentration (mg/L)
90	36
75	36
50	36
25	70.6
10	254.9
5	449.6

Figure 17. Current median TSS concentrations within the Little Arkansas R. Watershed.



3. SOURCE INVENTORY AND ASSESSMENT

Point Sources: There are 64 NPDES permitted facilities within the Little Arkansas River watershed (Figure 18). Of these, there are 15 discharging industrial facilities, 17 discharging municipal facilities, and five MS4 stormwater permits. There are 21 non-overflowing facilities that do not discharge and six facilities that discharge to permitted municipal wastewater treatment plants.

The discharging industrial facilities are detailed in Table 10. The AGCO Corporation discharges treated wastewater with an average TSS concentration of 8 mg/L. The NCRA facility discharges only when their disposal wells are down for maintenance. Typically this facility has discharged a few times per year and monitors the TSS concentrations and load being discharged. The discharge monitoring reports from the NCRA facility indicates the facility has a reported average TSS concentration of 51 mg/l and daily TSS load of 614 lbs/day while discharging under this permit. The Westar Energy facility monitors TSS concentrations in their discharge, which averages 12.7 mg/L of TSS. The Wichita ASR Phase II Treatment plant has only operated a eight days in July of 2012. This facility monitors TSS discharging concentrations on a monthly bases when discharging. There are only two discharge TSS samples on record, with the highest discharge TSS concentration being reported at 45 mg/L in

July of 2012. The highest discharge flow value reported from the ASR Phase II plant is 0.924 MGD in July of 2012. This facility will return sediment to the Little Arkansas River that was removed from the river with the water captured during their operation. Of the remaining industrial facilities the rest of these do not have a design flow or any reported discharge, with the exception of the BNSF Railway facility that has reported discharge on a few occasions.

Table 10. Discharging Permitted Industrial Facilities within the Little Arkansas River Watershed.

KS Permit #	Facility	NPDES #	Receiving Stream	Design Flow (MGD)	Type	TSS Limit	Permit Expires
I-LA02-PO02	WICHITA ASR PHASE I TREATMENT PLANT	KS0099392	KISIWA CREEK	0.5	Aquifer Storage and Recovery		12/31/2017
I-LA07-PO02	AGCO CORPORATION	KS0080951	MIDDLE EMMA CREEK	0.256	Treated wastewater	31 mg/l daily avg; 60 mg/l daily max	10/31/2017
I-LA07-PR01	BUILDERS CONCRETE & SUPPLY / HESSTON	KSG110032	OPOSSUM CREEK	0	Wastewater lagoon	100 mg/L daily max	9/30/2017
I-LA11-CO03	BPU-(MCPHERSON) POWER PLANT #3	KS0093602	LOWER ARKANSAS R/DRY TURKEY CREEK	0.077 Max	wastewater detention pond		12/31/2012
I-LA11-PO02	NCRA REFINERY - MCPHERSON	KS0000337	BULL CREEK	1.38	disposal well Backup retention pond	80 mg/L or 855 lbs/day	3/31/2017
I-LA11-PO04	BPU-MCPHERSON #2	KS0079758	LITTLE ARK RIVER/BULL CREEK	0.216	Cooling water		12/31/2012
I-LA11-PO09	BPU-(MCPHERSON) WT AIR STRIPPER	KS0088625	L. ARKANSAS R/DRY TURKEY CR/BULL CREEK	4.03	emergency discharge		12/31/2012
I-LA11-PR01	MCPHERSON CONCRETE PRODUCTS-WEST PLANT	KSG110090	BULL CREEK	0	wash water	100 mg/L daily max	9/30/2017
I-LA11-PR02	MID AMERICA READY MIX - MCPHERSON EAST	KSG110092	TURKEY CREEK	0	wash water basin	100 mg/L daily max	9/30/2017
I-LA13-PO01	BNSF RAILWAY CO - NEWTON	KS0001082	L. ARKANSAS R VIA SAND CR VIA DITCH	0	stormwater overflow		1/31/2017
I-LA13-PR01	BUILDERS CONCRETE - NEWTON FACILITY	KSG110009	SAND CREEK	0	wash water basins	100 mg/L daily max	9/30/2017
I-LA13-PR02	PRESTRESSED CONCRETE - NEWTON FACILITY	KSG110006	MUD CREEK	0	wash water basin	100 mg/L daily max	9/30/2017
I-LA20-PR01	KANSAS READY MIX - WICHITA	KSG110198	CHISHOLM CREEK TO WICHITA-VALLEY CENTER	0	wash water basin	100 mg/L daily max	9/30/2017
I-LA22-PO01	WESTAR ENERGY - HUTCHINSON ENERGY CTR	KS0079723	LITTLE ARKANSAS RIVER	0	overflow and stormwater	30 mg/L daily avg, 100 daily max	1/31/2014
I-LA24-PO01	WICHITA ASR PHASE II TREATMENT PLANT	KS0099694	LITTLE ARKANSAS RIVER	5.1	Process wastewater	Monitor	12/31/2014

Municipal permitted facilities are detailed in Table 11. All of the discharging municipal wastewater facilities have permit limits for TSS. All of the mechanical facilities have TSS limits consisting of a 45 mg/L weekly average and a 30 mg/L monthly average. Facilities that operate lagoon systems each have TSS limits consisting of 120 mg/L weekly average and an 80 mg/L monthly average. According to the discharge monitoring reports the lagoon systems do not discharge consistently. Notably, the cities of Geneseo and Walton have very limited discharge data and the City of Windom does not have any reported discharge data on file.

The average TSS concentrations for the discharging facilities that have available data are detailed in Table 12. TSS concentrations discharged from mechanical facilities are well below the respective discharge limits and do not contribute to the TSS impairment within the watershed. TSS concentrations associated with lagoon systems are all below their permit limits with the exception of the City of Goessel. The lagoon systems do not significantly contribute

to the TSS loading within the watershed due to their small and inconsistent discharge volumes. Many of these facilities likely only discharge during wetter conditions, in which case loading from these systems would be inconsequential compared to runoff from the surrounding watershed.

There are five MS4 permits within the watershed associated with the cities of Kechi, McPherson, Newton, Valley Center, and Park City. These MS4 permits expired in 2009, but are still in effect until the new MS4 permits are issued. The MS4 permits within the watershed follow a general permit format, requiring six minimum controls to be implemented throughout the permitted areas. The new permits will require the implementation of at least one BMP to address total suspended solids within a two year period following the permit renewal, along with subsequent monitoring to assess relative impact from the MS4 areas.

The non-overflowing permitted facilities are prohibited from discharging but may contribute TSS loads under extreme precipitation or flooding events. Such events would not occur at a frequency or for a duration to cause impairment within the watershed.

Table 11. Municipal Permitted facilities within the Little Arkansas R. watershed.

KS Permit #	Facility	NPDES #	Receiving Stream	Design Flow (MGD)	Type	TSS Limit	Permit Expires
M-LA02-OO01	BURRTON, CITY OF	KS0049786	KISIWA CREEK	0.155	4 cell lagoon	120 mg/l weekly, 80 mg/l monthly	12/31/2015
M-LA03-OO01	GALVA, CITY OF	KS0022560	TURKEY CREEK VIA UNNAMED TRIBUTARY	0.058	5 cell lagoon	120 mg/l weekly, 80 mg/l monthly	9/30/2017
M-LA04-OO02	GENESEO, CITY OF	KS0098175	LITTLE ARKANSAS RIVER	0.021	3 cell lagoon	120 mg/l weekly, 80 mg/l monthly	12/31/2013
M-LA05-OO02	GOESSEL, CITY OF	KS0081060	EMMA CREEK VIA MIDDLE EMMA CREEK	0.093	4 cell lagoon	120 mg/l weekly, 80 mg/l monthly	9/30/2017
M-LA08-OO01	INMAN, CITY OF	KS0080292	L. ARKANSAS R VIA BLAZE FORK CR	0.132	4 cell lagoon	120 mg/l weekly, 80 mg/l monthly	6/30/2016
M-LA10-OO02	LITTLE RIVER, CITY OF	KS0085758	LITTLE ARKANSAS RIVER	0.1014	4 cell lagoon	120 mg/l weekly, 80 mg/l monthly	9/30/2015
M-LA12-OO01	MOUNDRIDGE, CITY OF	KS0021008	BLACK KETTLE CREEK	0.233	4 cell lagoon	120 mg/l weekly, 80 mg/l monthly	12/31/2017
M-LA17-OO01	WALTON, CITY OF	KS0026140	SAND CREEK	0.0379	3 cell lagoon	120 mg/l weekly, 80 mg/l monthly	6/30/2017
M-LA18-OO01	WINDOM, CITY OF	KS0051721	L. ARKANSAS R VIA UNNAMED TRI.	0.0275	3 cell lagoon	120 mg/l weekly, 80 mg/l monthly	1/31/2017
M-LA01-OO01	BUHLER, CITY OF	KS0027553	L. ARKANSAS R	0.168	Mechanical Plant	45 mg/l weekly, 30 mg/L Monthly	7/31/2017
M-LA06-OO01	HALSTEAD, CITY OF	KS0026263	L. ARKANSAS R	0.42	Mechanical Plant	45 mg/l weekly, 30 mg/L Monthly	7/31/2017
M-LA07-OO01	HESSTON, CITY OF	KS0022799	L. ARKANSAS R VIA EMMA CR	1.3	Mechanical Plant	45 mg/l weekly, 30 mg/L Monthly	1/31/2017
M-LA11-OO01	MCPHERSON, CITY OF	KS0036196	L. ARK VIA DRY TURKEY CR	2	Mechanical Plant	45 mg/l weekly, 30 mg/L Monthly	8/31/2017
M-LA13-IO01	NEWTON, CITY OF	KS0038971	L. ARKANSAS R VIA SAND CR	3	Mechanical Plant	45 mg/l weekly, 30 mg/L Monthly	12/31/2012
M-LA15-OO02	SEDGWICK, CITY OF	KS0081108	SAND CREEK	0.292	Mechanical Plant	45 mg/l weekly, 30 mg/L Monthly	7/31/2017
M-LA16-OO02	VALLEY CENTER, CITY OF	KS0099074	LITTLE ARKANSAS RIVER	0.07	Mechanical Plant	45 mg/l weekly, 30 mg/L Monthly	6/30/2017
M-LA19-OO02	CHISHOLM CREEK UTILITY AUTHORITY	KS0089176	L. ARKANSAS R. VIA CHISHOLM CR	2.16	Mechanical	45 mg/l weekly, 30 mg/L Monthly	12/31/2017
M-LA09-SU01	KECHI, CITY OF	KSR041013		0	MS4		9/30/2009
M-LA11-SN01	MCPHERSON, CITY OF	KSR044013		0	MS4		9/30/2009
M-LA13-SN01	NEWTON, CITY OF	KSR044014		0	MS4		9/30/2009
M-LA16-SU01	VALLEY CENTER, CITY OF	KSR041037		0	MS4		9/30/2009
M-LA19-SU01	PARK CITY, CITY OF	KSR041027		0	MS4		9/30/2009

Facilities that discharge and monitor TSS concentrations within their effluent are detailed in Table 12. The mechanical plants have low TSS concentrations within their effluent. Whereas lagoon systems tend to have higher TSS concentrations due to the fact that lagoon systems typically discharge during wet periods and they lack the technology to remove suspended materials. Lagoons generally do not discharge continuously and the discharge volumes are

small. Therefore the TSS loads originating from lagoon systems are unlikely to contribute significantly to the TSS loads in the Little Arkansas watershed.

Table 12. Average discharge TSS concentrations for facilities with monitoring data.

KS Permit #	Facility	Type	Monitoring Frequency	TSS Concentration Average mg/L	Avg. Discharge (MGD)
M-LA01-OO01	BUHLER, CITY OF	Mechanical Plant	monthly	15	0.139
M-LA02-OO01	BURRTON, CITY OF	4 cell lagoon	quarterly	71	
M-LA03-OO01	GALVA, CITY OF	5 cell lagoon	quarterly	61	
M-LA04-OO02	GENESEO, CITY OF	3 cell lagoon	quarterly	61	
M-LA05-OO02	GOESSEL, CITY OF	4 cell lagoon	quarterly	88	
M-LA06-OO01	HALSTEAD, CITY OF	Mechanical Plant	monthly	5.5	0.127
M-LA07-OO01	HESSTON, CITY OF	Mechanical Plant	monthly	8.6	0.388
M-LA08-OO01	INMAN, CITY OF	4 cell lagoon	quarterly	80	
M-LA10-OO02	LITTLE RIVER, CITY OF	4 cell lagoon	monthly	33	
M-LA11-OO01	MCPHERSON, CITY OF	Mechanical Plant	twice monthly	9.7	1.523
M-LA12-OO01	MOUNDRIDGE, CITY OF	4 cell lagoon	monthly	76	
M-LA13-IO01	NEWTON, CITY OF	Mechanical Plant	weekly	7	2.161
M-LA15-OO02	SEDGWICK, CITY OF	Mechanical Plant	monthly	20	0.088
M-LA16-OO02	VALLEY CENTER, CITY OF	Mechanical Plant	monthly	12	0.388
M-LA17-OO01	WALTON, CITY OF	3 cell lagoon	quarterly	10.5	
M-LA18-OO01	WINDOM, CITY OF	3 cell lagoon	quarterly	NA	
M-LA19-OO02	CHISHOLM CREEK UTILITY AUTHORITY	Mechanical	weekly	11.4	1.402

Livestock and Waste Management Systems: There are 130 certified, permitted or registered animal feeding operations (AFOs) within the Little Arkansas Watershed covered by this TMDL (see Appendix C). Five of these facilities have federal NPDES permits. All of these livestock facilities have waste management systems designed to minimize runoff entering their operations and detain runoff emanating from their facilities. These facilities are designed to retain a 25-year, 24-hour rainfall/runoff event as well as an anticipated two weeks of normal wastewater from their operations. Typically, this rainfall event coincides with streamflow that occurs less than 1-5% of the time. It is unlikely TSS loading would be attributable to properly operating permitted facilities, though extensive loading may occur if any of these facilities were in violation and discharged.

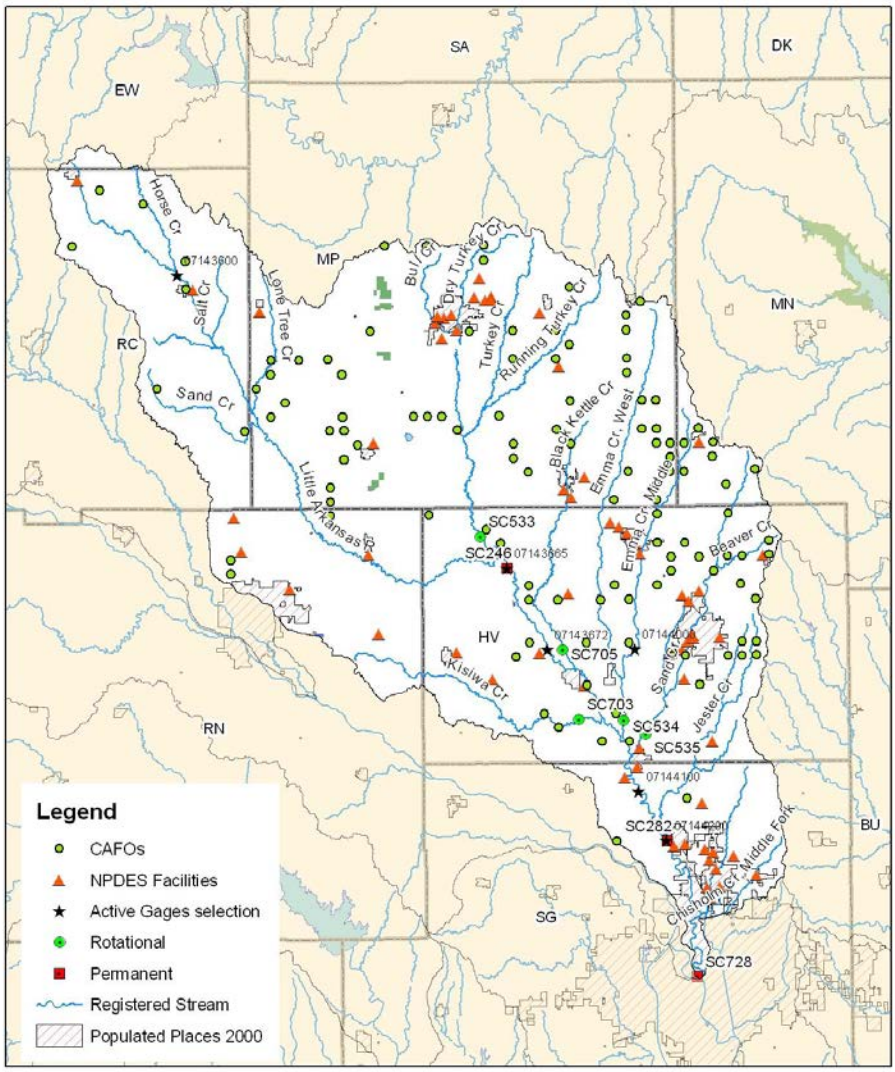
Though the total potential number of animals is approximately 234,854 animal units in the watershed, the actual number of animals at the feedlot operations is typically less than the allowable permitted number.

According to the 2007 Agriculture Census and as detailed in Table 13, farms within Ellsworth, Rice, and Marion counties are the largest within the watershed. Farms are smaller and more numerous within McPherson, Reno, Harvey and Sedgwick counties. Reno County contains the highest number of farmland acres and the largest number of cattle (2010 Kansas Farm Facts). Non-permitted grazing livestock should not contribute to the TSS loading if they are managed properly, however they could contribute to the TSS loading within the watershed if they overgraze and denude pasture or riparian buffers or have access to streams.

Table 13. Agriculture Census Data for counties within the Little Arkansas R. watershed.

County	2007 Number of Farms	2007 Land in Farm Acres	Cattle Head 2010
Ellsworth	408	365,046	28,000
Rice	580	428,422	57,000
McPherson	1,142	566,309	55,000
Reno	1,749	780,893	69,000
Harvey	829	338,598	24,000
Marion	974	599,022	59,000
Sedgwick	1,419	510,308	34,000

Figure 18. Permitted facilities and CAFOs in the Little Arkansas River watershed.



Population Density: Table 14 summarizes the population for the cities within the Little Arkansas watershed based on the 2000 and 2010 U.S. Census data. According to the 2000 U.S. Census block information, the watershed has 115,401 people, with a population density of 81 people/square mile. There are approximately 58,400 people residing within the cities that are completely within the watershed boundary with a large portion of the remaining population living within the Hutchinson and Wichita areas that are within the watershed. Overall, the population within the watershed is increasing based on the 2010 U.S. Census data, with the largest population increases in cities within Harvey and Sedgwick counties.

Table 14. U.S. Census Population Data within Little Arkansas River watershed**.**

City	2000 Population	2010 Population	% Change	County
NEWTON	17190	19132	11.30	Harvey
MCPHERSON	13770	13155	-4.47	McPherson
PARK CITY	5814	7297	25.51	Sedgwick
VALLEY CENTER	4883	6822	39.71	Sedgwick
HESSTON	3509	3709	5.70	Harvey
HALSTEAD	1873	2085	11.32	Harvey
KECHI	1038	1909	83.91	Sedgwick
NORTH NEWTON	1522	1759	15.57	Harvey
MOUNDRIDGE	1593	1737	9.04	McPherson
SEDGWICK	1537	1695	10.28	Harvey/Sedgwick
INMAN	1142	1377	20.58	McPherson
BUHLER	1358	1327	-2.28	Reno
BURRTON	932	901	-3.33	Harvey
GALVA	701	870	24.11	McPherson
LITTLE RIVER	536	557	3.92	Rice
GOESSEL	565	539	-4.60	Marion
GENESEO	272	267	-1.84	Rice
WINDOM	137	130	-5.11	McPherson
Partially Within Watershed				
WICHITA	344284	382368	11.06	Sedgwick
HUTCHINSON	40787	42080	3.17	Reno
BEL AIRE	5836	6769	15.99	Sedgwick
CANTON	829	748	-9.77	McPherson
WALTON	284	235	-17.25	Harvey

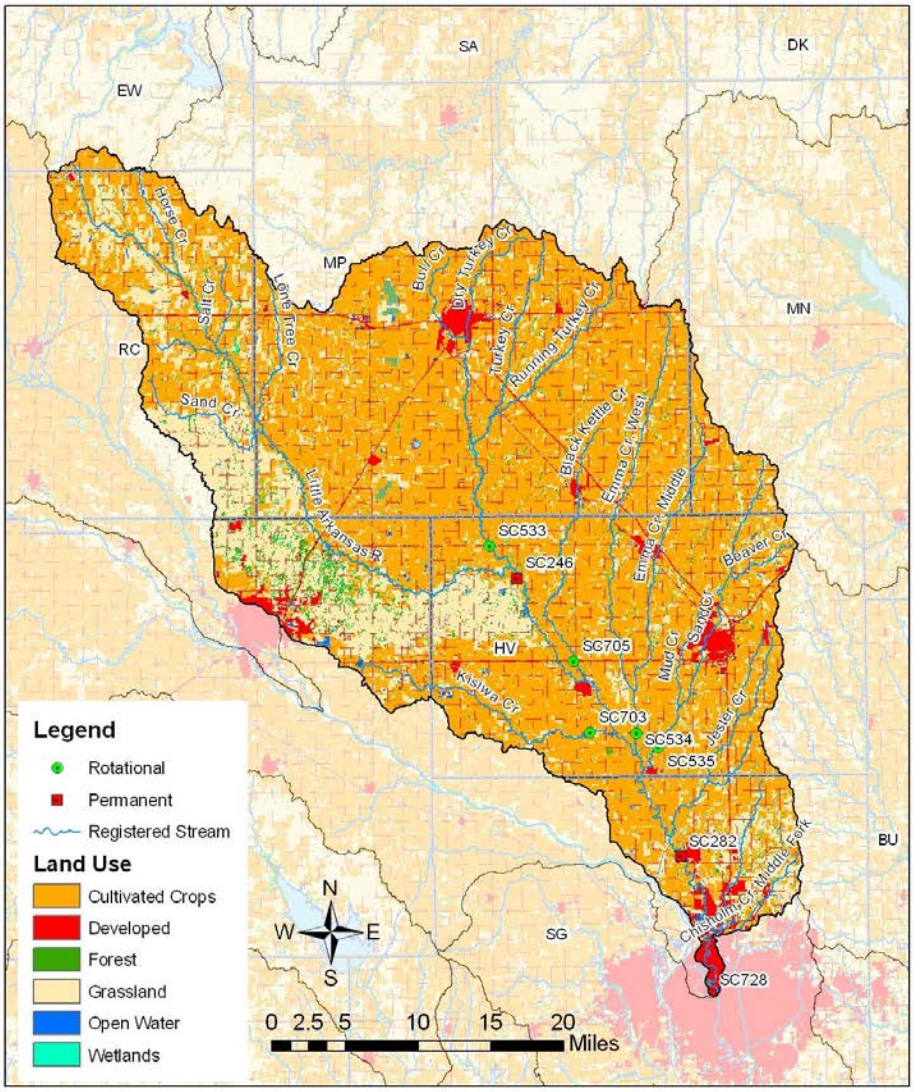
On-Site Waste Systems: Households outside of the municipalities that operate wastewater treatment facilities are presumably utilizing on-site septic systems. The Spreadsheet Tool for Estimating Pollutant Load (STEPL) was utilized to identify the number of septic systems within the HUC12s within the watershed. According to STEPL, there are approximately 4,285 septic systems within the Little Arkansas River watershed with an anticipated failure rate of 0.93%. Failing septic systems have negligible loading potential for TSS in the streams within the watershed. Additionally, since this watershed is so large and there are so many people residing within the municipalities within the watershed, there is not likely sufficient density of failing on-site septic systems to contribute to the suspended solids impairment within the Little Arkansas River watershed.

Land Use: Land use within the Little Arkansas watershed is dominated by cropland (64%) and grassland (24%) according to the 2001 National Land Cover Data. Urban areas, such as residential, commercial and industrial uses as well as open space like roads and lawn grasses, comprise about 8% of the watershed. The land use percentages for the watershed are listed in Table 15 and further detailed in the land use map (Figure 19). Row crop production in close proximity to the streams within the watershed can contribute suspended solids to the surface water via overland flow.

Table 15. Little Arkansas River watershed landuse summary.

Land Use	Acres	Percent
Cropland	578,811	64%
Grassland	220,632	24%
Developed	73,210	8%
Forest	25,546	3%
Wetlands	6,524	1%
Open Water	5,743	1%

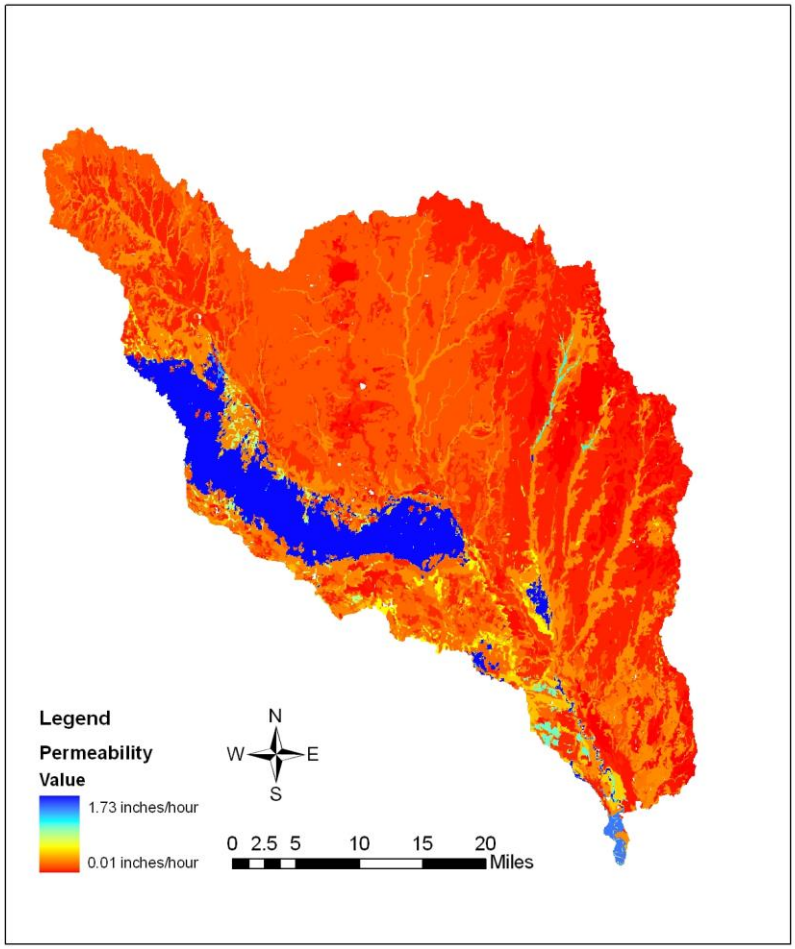
Figure 19. Land Use (2001 NLCD) map for the Little Arkansas Watershed.



Contributing Runoff: The Little Arkansas watershed has a mean soil permeability value of 1.64 inches/hour, ranging from 0.01 to 1.73 inches/hour according to the NRCS STATSGO database. About 55% of the watershed has a permeability value less than 1.14 inches/hour, which contributes to runoff during very low rainfall intensity events. According to a USGS open-file report (Juracek, 2000), the threshold soil permeability values are set at 3.43 inches/hour for very high, 2.86 inches/hour for high, 2.29 inches/hour for moderate, 1.71 inches/hour for low, 1.14 inches/hour for very low, and 0.57 inches/hour for extremely low soil-permeability. Runoff is primarily generated as infiltration excess with rainfall intensities greater than soil permeability. As the watersheds' soil profiles become saturated, excess overland flow is produced. The majority of the nonpoint source sediment runoff will be contributed to large areas throughout the watershed that are not within the river alluvium along the Little Arkansas River, which are detailed in dark blue areas in Figure 20. The higher

permeable areas in Figure 20 tend to align with the grassland areas as seen in the land use map in Figure 19. Therefore, sediment runoff is predominantly associated with cropland acreage within the watershed.

Figure 20. Soil permeability map for the Little Arkansas River watershed.



Background: Sediment and suspended solids are part of the landscape, in the soil profile as well as within the stream channels. There will always be extreme precipitation events that generate erosion from the land surface and transport solids into the stream channel as part of the aggregation/degradation process of fluvial geomorphology.

4.0 ALLOCATION OF POLLUTION REDUCTION RESPONSIBILITY

Point Sources: Even though the TSS impairment in the Little Arkansas River watershed is not attributable to wasteloads associated with discharging facilities within the watershed, Wasteload Allocations (WLA) will be established for the facilities that consistently discharge

using their existing permit limits and design flows. Ongoing inspections and monitoring of these NPDES sites will be made to ascertain the contributions that have been made by the sources. These wastewater treatment plants should comply with any future permit conditions. The total WLA for the watershed is 3.02 tons/day. Individual WLAs are not specified for the Wichita ASR facilities since these facilities do not currently discharge. If and when they do discharge their WLA may be derived from the reserve WLA for the watershed as detailed in Table 16.

Table 16. WLA for discharging facilities.

PERM_NO	FAC_NAME	Design Flow Discharge (cfs)	Discharge TSS Concentration (mg/L)	WLA (tons/day)	Station
I-LA22-PO01	WESTAR ENERGY - HUTCHINSON ENERGY CTR	0.48	20	0.03	246
M-LA01-OO01	BUHLER, CITY OF	0.26	30	0.02	246
M-LA04-OO02	GENESEO, CITY OF	0.03	80	0.01	246
M-LA08-OO01	INMAN, CITY OF	0.20	80	0.04	246
M-LA10-OO02	LITTLE RIVER, CITY OF	0.16	80	0.03	246
M-LA18-OO01	WINDOM, CITY OF	0.04	80	0.01	246
M-LA06-OO01	HALSTEAD, CITY OF	0.65	30	0.05	282
I-LA11-PO02	NCRA REFINERY - MCPHERSON	2.13	80 or 855 lbs/day	0.43	533
I-LA11-PO04	BPU-MCPHERSON #2	0.33	20	0.02	533
M-LA03-OO01	GALVA, CITY OF	0.09	80	0.02	533
M-LA11-OO01	MCPHERSON, CITY OF	3.09	30	0.25	533
I-LA07-PO02	AGCO CORPORATION	0.40	31	0.03	534
M-LA05-OO02	GOESSEL, CITY OF	0.14	80	0.03	534
M-LA07-OO01	HESSTON, CITY OF	2.01	30	0.16	534
M-LA13-IO01	NEWTON, CITY OF	4.64	30	0.38	535
M-LA15-OO02	SEDGWICK, CITY OF	0.45	30	0.04	535
M-LA17-OO01	WALTON, CITY OF	0.06	80	0.01	535
M-LA02-OO01	BURRTON, CITY OF	0.24	80	0.05	703
M-LA12-OO01	MOUNDRIDGE, CITY OF	0.36	80	0.08	705
M-LA16-OO02	VALLEY CENTER, CITY OF	0.11	30	0.01	728
M-LA19-OO02	CHISHOLM CREEK UTILITY AUTHORITY	3.34	30	0.27	728
Watershed Reserve	Reserve - Available for ASR Phase I and Phase II	8.66	45	1.05	282
Total WLA				**3.02**	

There will be Wasteload Allocations of zero assigned to the concrete batch plants, pre-treatment facilities, non-discharging facilities and the confined animal feeding operations because all of these facilities should have no discharge within the watershed. A detailed list of all facilities and their respective assigned WLA is listed in Appendix A.

The Wasteload Allocation for the MS4 stormwater is provided by proportioning the remaining load capacity from nonpoint source loads, after accounting for the NPDES WLA and the Margin of Safety. This was done by assuming load contributions would arise from the developed areas within the HUC12s containing the MS4 areas. Thus, the MS4 WLA was based on the proportion of developed land in these HUC12s as detailed in Table 15 and applies for flows at and above median flow conditions at the respective stations within the Little Arkansas River watershed. The MS4 allocations for the municipalities within the watershed are detailed in Table 17.

A specified Wasteload Allocation has not been specifically assigned to the two permits associated with the Wichita ASR treatment plant due to the nature of the associated discharge and provisions of the Kansas Water Quality Standards. Additionally these plants do not discharge at the current time and have not consistently discharged since these facilities were permitted. These permits are associated with an aquifer storage and recovery project that

operates on the Little Arkansas River during high flow conditions. The discharge from the facility contains sediment that originated from the Little Arkansas River. The water quality standards and permits allow for the disposal of pre-sedimentation sludge (slurry) from the water treatment facility back to the Little Arkansas River. Pursuant to Kansas Water Quality Standards, this sludge can be returned to the originating river provided it does not create toxic conditions or violate the narrative provisions of the water quality standards. The permits contain a requirement to conduct whole effluent toxicity testing on the returning sludge slurry to determine toxicity and to inspect the outfall location and monitor the Little Arkansas River for violations of the narrative provisions pursuant to K.A.R. 28-16-28 (b-f). The permits indicate there is no potential to violate Kansas Surface Water Quality Standards. If the Wichita ASR treatment plants consistently discharge and WLAs are necessary, the WLAs are initially accounted for and derived from the reserve WLA for the watershed. The reserve WLA is based on the maximum TSS concentrations observed in the discharge at the ASR Phase II facility (45mg/L) and the total design flow for both facilities (5.6 MGD). Based on current operations, these facilities will be well under the established reserved WLA since they rarely operate. Additionally, operations associated with these facilities are limited to short durations when there is relatively high flow in the Little Arkansas River. Specific WLAs for these facilities and the reserve WLA will be refined as more monitoring and operational data becomes available. Additionally, the reserve WLA may become available for future dischargers in the watershed as necessary.

Table 17. MS4 Allocations as assigned for each facility represented as the percent of the Load Allocation for the respective KDHE stations. MS4 allocations are only applicable in the 0-50% flow exceedance range.

Permit Number	MS4 Municipality	Monitoring Station	MS4 Allocation (% of Load Allocation)
M-LA11-SN01	McPherson	SC533	3.2 %
M-LA13-SN01	Newton	SC535	7.5 %
M-LA16-SU01	Valley Center	SC728	4.0 %
M-LA09-SU01	Kechi	SC728	1.6 %
M-LA19-SU01	Park City	SC728	6.9 %

Nonpoint Sources: The load allocation for nonpoint sources is the remaining load capacity after the Wasteload Allocations for NPDES wastewater and MS4 stormwater have been accounted. Nonpoint sources are assumed to be minimal within the tributaries under extremely low flow conditions. The load allocation increases proportionally as flows increase. Excess TSS loading comes predominantly from nonpoint pollution sources under normal and high flow conditions. Under extreme high flow events, with flow exceedance values less than 5%, the TSS impairment may not be technically and/or economically feasible for management.

The respective load allocations at the various KDHE sampling stations throughout the watershed are detailed in Table 18 for the median flow condition and Table 19 for the 10% flow exceedance (high flow) condition. The TMDL for each station on the Little Arkansas River are detailed in Figures 21 thru 23.

Table 18. TSS TMDL on the Little Arkansas River at the median flow condition.

Station Location	Station	Flow (cfs)	WLA (tons/day)	MS4 (tons/day)	LA (tons/day)	Reserve WLA (tons/day)	MOS (tons/day)	TMDL (tons/day)
Little Ark Alta Mills	SC246	18.0	0.857	0.000	0.718	0.000	0.175	1.750
Little Ark Valley Center	SC282	67.0	1.692	0.003	3.117	1.050	0.651	6.512
Little Ark Wichita	SC728	70.9	1.971	0.401	2.779	1.050	0.689	6.890

Table 19. TSS TMDL on the Little Arkansas River at 10% flow exceedance.

Station Location	Station	Flow (cfs)	WLA (tons/day)	MS4 (tons/day)	LA (tons/day)	Reserve WLA (tons/day)	MOS (tons/day)	TMDL (tons/day)
Little Ark Alta Mills	SC246	269.4	0.857	1.38	164.60	0.00	18.54	185.38
Little Ark Valley Center	SC282	655.8	1.692	3.73	399.66	1.05	45.13	451.26
Little Ark Wichita	SC728	693.9	1.971	57.15	369.53	1.05	47.74	477.45

Figure 21. TSS TMDL on Little Arkansas River at Alta Mills, SC246.

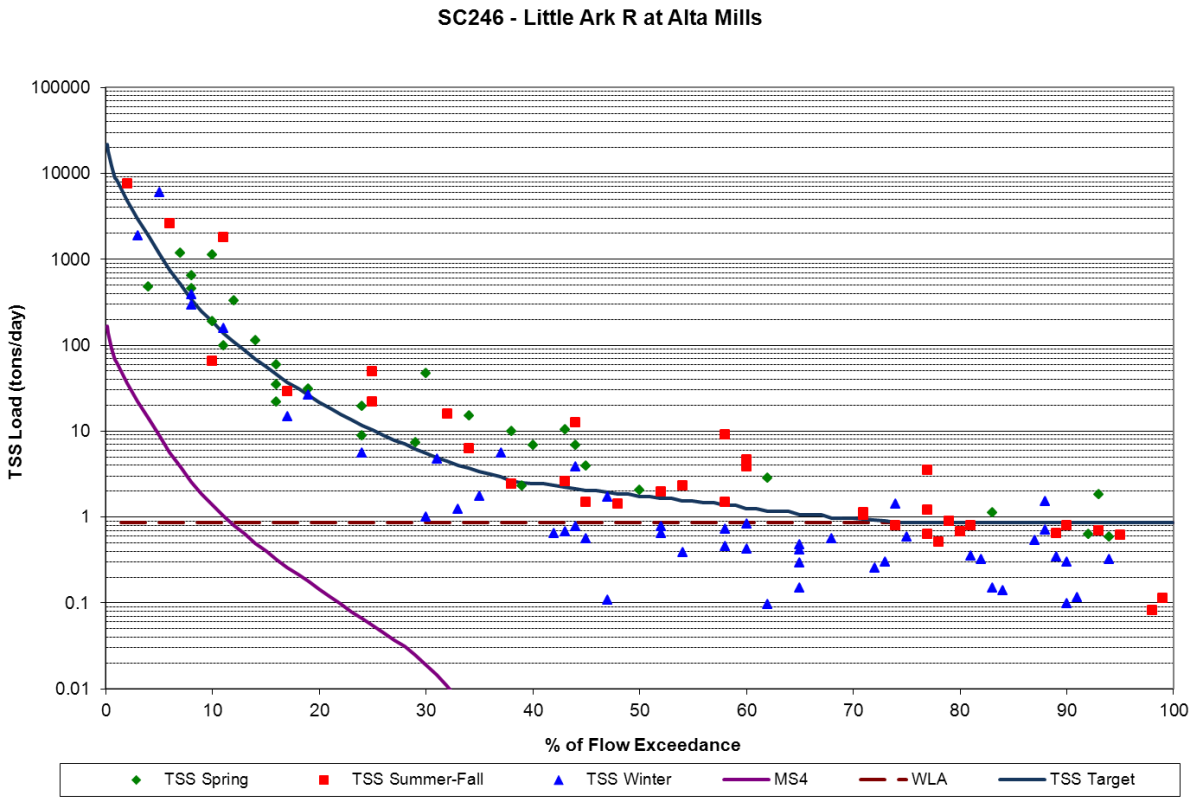


Figure 22. TSS TMDL on Little Arkansas River at Valley Center, SC282.

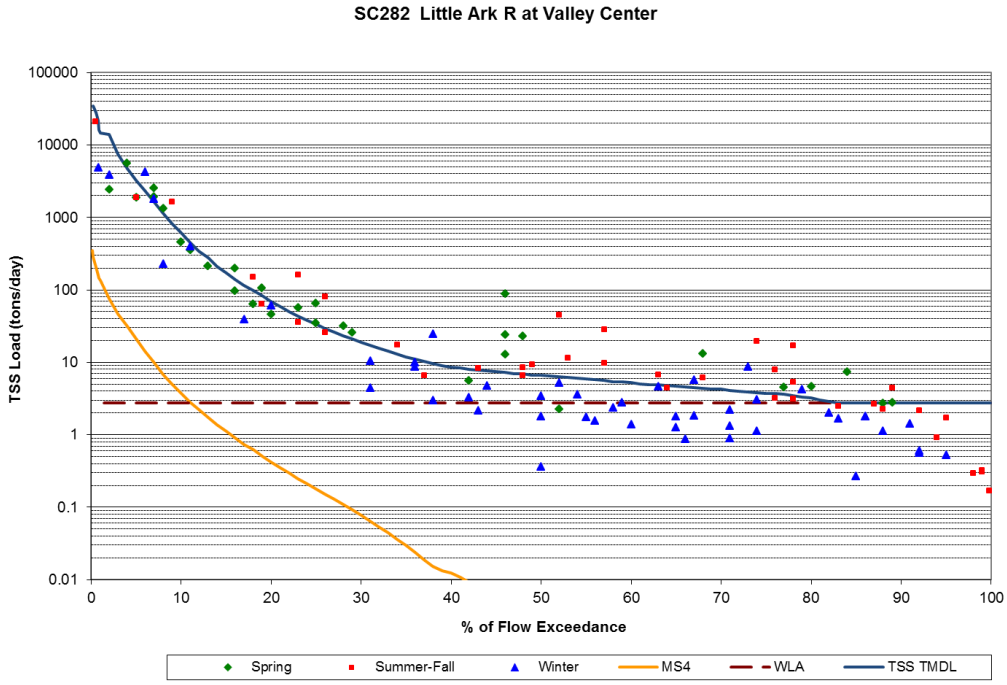
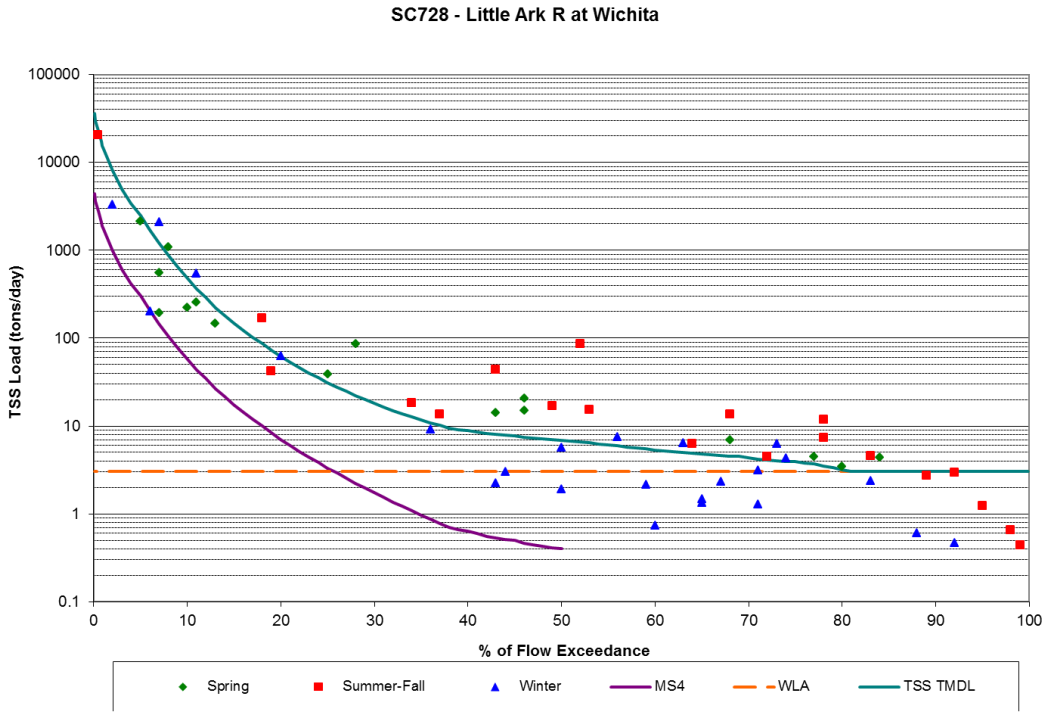


Figure 23. TSS TMDL on Little Arkansas RivertichitaSC728.



Defined Margin of Safety: The margin of safety is explicit and provides some hedge against the uncertainty of daily allocated TSS loading. For this TSS TMDL, the margin of safety will be 10% of the TSS TMDL.

State Implementation Priority: Due to the high frequency and magnitude of the TSS excursions within the watershed, this TMDL will be High Priority for implementation.

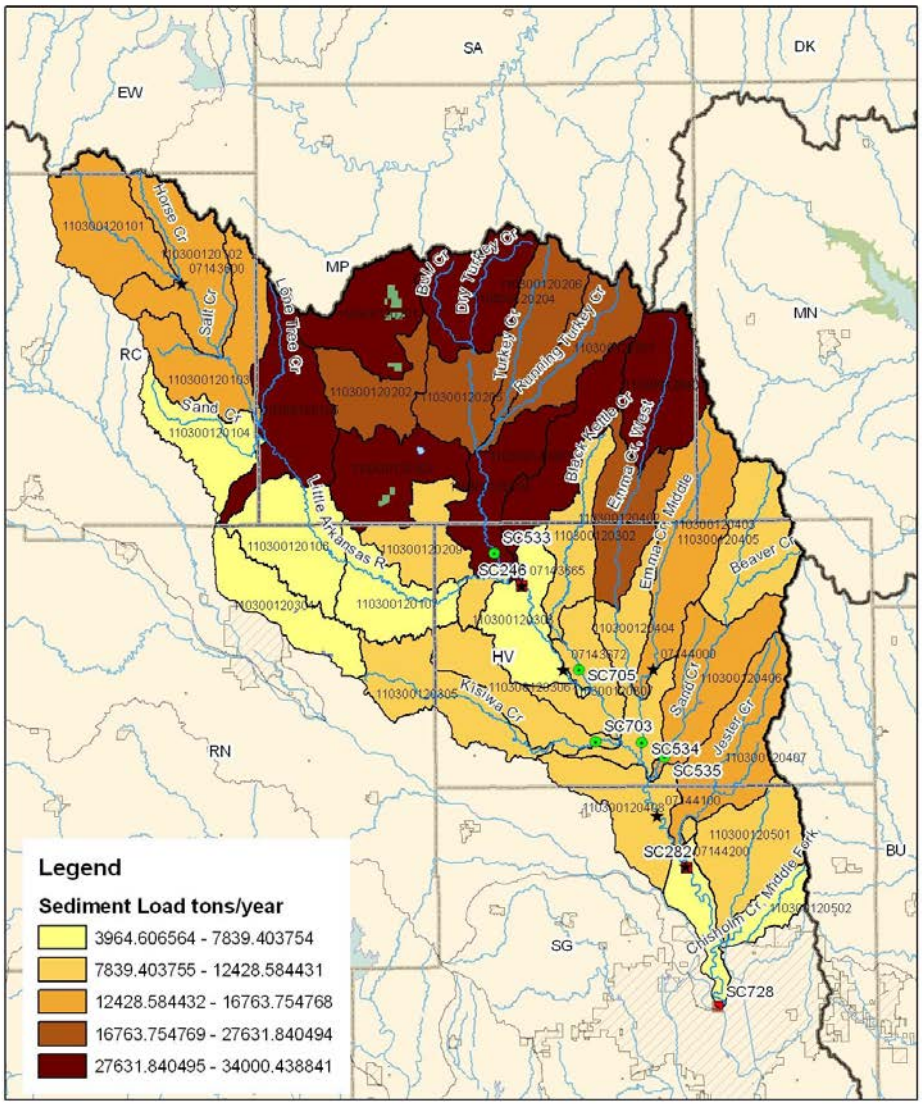
Unified Watershed Assessment Priority Rankings: This watershed lies within the Little Arkansas Subbasin (HUC 8: 11030012) with a priority ranking of 14 (Highest Priority for restoration work).

Priority HUC 12s: The Spreadsheet Tool for Estimating Pollutant Load (STEPL) was utilized to identify priority HUC12s within the watershed. STEPL is a simple watershed model that provides both agricultural and urban annual average sediment and nutrient simulations as well as implementation evaluation of best management practices. Preliminary STEPL results for sediment are prioritized in Table 20. The highest priority HUC 12s are within the Turkey Creek subwatershed and above station SC246 as seen in Figure 24. The top ten ranking HUC12s should be initial priority for further assessment to evaluate effective implementation.

Table 20. Priority HUC12s as identified through STEPL**.**

HUC12	Sediment Load Tons/Year	Sediment Load Tons/Acre/Year	Priority Rank
110300120105	34000.44	0.94	1
110300120203	33217.57	1.16	2
110300120401	31842.41	1.04	3
110300120301	31743.60	1.17	4
110300120208	30850.59	1.22	5
110300120201	30623.20	1.12	6
110300120204	29527.64	0.96	7
110300120207	27631.84	1.14	8
110300120202	26724.41	1.24	9
110300120206	26087.76	1.11	10
110300120402	26055.60	1.05	11
110300120205	25183.58	1.20	12
110300120403	16763.75	0.41	13
110300120407	15556.43	0.47	14
110300120102	14730.91	0.43	15
110300120103	13780.20	0.42	16
110300120101	13660.52	0.40	17
110300120406	12832.15	0.41	18
110300120404	12428.58	0.48	19
110300120209	12165.49	0.49	20
110300120405	11705.24	0.39	21
110300120305	11495.43	0.40	22
110300120408	10955.12	0.41	23
110300120302	10182.74	0.51	24
110300120307	9742.25	0.49	25
110300120501	9715.81	0.33	26
110300120306	8871.44	0.40	27
110300120303	7839.40	0.33	28
110300120502	6157.36	0.29	29
110300120107	5163.73	0.22	30
110300120106	5102.39	0.17	31
110300120104	4119.57	0.18	32
110300120304	3964.61	0.17	33

Figure 24. Little Arkansas River watershed STEPL results for Sediment.



5. IMPLEMENTATION

The excess TSS loads in the Little Arkansas River are closely associated with areas utilized for crop production. The largest TSS loads typically occur during spring and summer runoff. The TSS loads are the smallest in the winter months because of low streamflow. There is a good potential that best management practices will control TSS loads and improve water quality. Some of the recommended practices are as follows:

Desired Implementation Activities

1. Implement and maintain conservation farming, including conservation tilling, contour farming and no-till farming to reduce runoff and suspended solids loads from tributaries to the Little Arkansas River.
2. Improve riparian conditions along stream systems by installing grass and/or forest buffer strips to trap suspended solids, and reducing livestock activities within riparian areas to reduce stream bank erosion.
3. Install pasture management practice, including proper stock density, to reduce soil erosion and storm runoff.
4. Minimize road and bridge construction impacts on streams.
5. Maintain permit limits for TSS in federal and state permits, inspect permitted facilities and monitor wastewater discharges to assure compliance.
6. Incorporate this TMDL into the Little Arkansas Basin WRAPS program.
7. Establish urban and construction stormwater management practices to abate sediment loading in urban areas within the watershed.

Implementation Program Guidance

NPDES – Municipal Program – KDHE

a. Monitor effluent from wastewater treatment plants to determine their total suspended solids contributions.
b. Ensure proper monitoring, permitting, and operations of municipal wastewater systems to reduce total suspended solids discharges.
c. Incorporate sediment control for the MS4 permitted areas within the watershed.
d. Monitor total suspended solids upstream and downstream of the Wichita ASR facilities when the facilities consistently discharge.

Nonpoint Source Pollution Technical Assistance – KDHE

a. Support Section 319 demonstration projects for reduction from livestock operations.
b. Provide technical assistance on practices geared to establishment of vegetative buffer strips.
c. Provide technical assistance on sediment and pasture management in vicinity of streams,
d. Support Watershed Restoration and Protection Strategy (WRAPS) efforts for the Little Arkansas River watershed.
e. Incorporate the provisions of this TMDL into any Little Arkansas WRAPS documents, especially the 9-element watershed plan.
f. Encourage investment by the Wichita stormwater program into WRAPS BMP projects.

Water Resource Cost Share Nonpoint Source Pollution Control Program – KDA-DOC

a. Apply conservation farming practice, including terraces and waterways, sediment control basins, and constructed wetlands within the watershed.
b. Provide sediment control practices to minimize erosion and sediment transport from cropland and grassland in the watershed.

Riparian Protection Program –KDA-DOC

a. Establish or restore natural riparian systems, including vegetative filter strips and streambank vegetation along the Little Arkansas River and its tributaries.
b. Develop riparian restoration projects along targeted stream segments, especially those areas impacted by runoff.
c. Promote wetland construction to reduce runoff and assimilate sediment loadings.
d. Coordinate riparian management within the watershed.

Buffer Initiative Program – KDA-DOC

a. Install grass buffer strips near streams,
b. Leverage Conservation Reserve Enhancement Program to hold riparian land out of production.

Extension Outreach and Technical Assistance – Kansas State University

a. Educate agricultural producers on riparian and sediment management techniques,
b. Provide technical assistance on sediment management,
c. Continue Section 319 demonstration projects on sediment management,
d. Support outreach efforts by Little Arkansas River WRAPS.

Time Frame for Implementation: Pollutant reduction practices should be installed within the top priority subwatersheds before 2015, with follow-up implementation, including other subwatersheds over 2016-2020.

Targeted Participants: Primary participants for implementation will likely be the agricultural producers operating within the drainage of priority subwatersheds. Implementation activities should target those areas with greatest potential to impact the river's TSS levels:

1. Total row crop acreage and gully locations
2. Conservation compliance on highly erodible areas
3. Acreage of poor rangeland or overstocked pasture
4. Livestock use of riparian areas and condition of riparian areas
5. Unvegetated or graded roadside ditches
6. Construction projects without erosion control techniques
7. Uncontrolled entry points for urban runoff
8. Impervious area generating increased runoff

Some inventory of local needs should be conducted in 2013 to identify such activities. Such an inventory would be done by local program managers with appropriate assistance by commodity representatives and state program staff in order to direct state assistance programs to the principal activities influencing the quality of the river and its tributaries in the watershed during the implementation period of this TMDL.

Milestone for 2016: In accordance with the TMDL development schedule for the State of Kansas, the year 2016 marks the next cycle of 303(d) activities in the Lower Arkansas Basin. At that point in time, suspended solids data from the KDHE sampling sites within the

watershed should show indications of declining concentrations relative to the pre-2012 data, particularly at normal conditions. By this date, the applicable MS4 areas within the watershed should be well underway in implementing the appropriate landscape treatment to decrease urban runoff loadings. Additional BMP placement in the Little Arkansas watershed can be facilitated by offsite implementation under the MS4 stormwater management plans.

Delivery Agents: The primary deliver agents for program participation will be KDHE, the Little Arkansas WRAPS and Kansas State Extension. Implementation decisions and scheduling will be guided by planning documents prepared through Little Arkansas WRAPS and the 9-element watershed plan.

Reasonable Assurances:

Authorities: The following authorities may be used to direct activities in the watershed to reduce pollution:

1. K.S.A. 65-164 and 165 empowers the Secretary of KDHE to regulate the discharge of sewage into the waters of the state.

2. K.S.A. 65-171d empowers the Secretary of KDHE to prevent water pollution and to protect the beneficial uses of the waters of the state through required treatment of sewage and established water quality standards and to require permits by persons having a potential to discharge pollutants into the waters of the state.

3. K.S.A. 2002 Supp. 82a-2001 identifies the classes of recreation use and defines impairment for streams.

4. K.A.R. 28-16-69 through 71 implements water quality protection by KDHE through the establishment and administration of critical water quality management areas on a watershed basis.

5. K.S.A. 2-1915 empowers the Kansas Department of Agriculture Division of Conservation (KDA-DOC) to develop programs to assist the protection, conservation and management of soil and water resources in the state, including riparian areas.

6. K.S.A. 75-5657 empowers the KDA-DOC to provide financial assistance for local project work plans developed to control nonpoint source pollution.

7. K.S.A. 82a-901, et. seq. empowers the Kansas Water Office to develop a state water plan directing the protection and maintenance of surface water quality for the waters of the state.

8. K.S.A. 82a-951 creates the State Water Plan Fund to finance the implementation of the *Kansas Water Plan*, including selected Watershed Restoration and Protection Strategies.

9. The *Kansas Water Plan* and the Lower Arkansas Basin Plan provide the guidance to state agencies to coordinate programs intent on protecting water quality and to target those programs to geographic areas of the state for high priority implementation.

Funding: The State Water Plan annually generates $16-18 million and is the primary funding mechanism for implementing water quality protection and pollution reduction activities in the state through the *Kansas Water Plan*. The state water planning process, overseen by the Kansas Water Office, coordinates and directs programs and funding toward watershed and water resources of highest priority. Typically, the state allocates at least 50% of the fund to programs supporting water quality protection. This watershed and its TMDL are located within a High Priority WRAPS area and should receive support for pollution abatement practices that lower the loading of sediment and nutrients.

Effectiveness: Implementation of erosion control and land treatment practices has long been shown to reduce sediment and suspended solids loadings to surface waters.

6. MONITORING

Ongoing bimonthly sampling will continue every year at stations SC246, SC282 and SC728. Future stream sampling will occur bimonthly at rotational stations: SC533, SC534, SC535, SC703, and SC705 every fourth year, with 2014 being the next scheduled sampling year. Monitoring of tributary levels of TSS during runoff events will help direct abatement efforts toward major contributors. Additionally, tracking the TSS loads from point sources should be done to determine their contributions to the watershed. Monitoring of TSS should be a condition of the MS4 permits within the watershed. Additionally, biological monitoring will continue to be conducted by KDHE at SB282. Supplemental biological monitoring should be conducted at other locations within the watershed and by the Wichita ASR treatment plant downstream of their outfalls.

7. FEEDBACK

Public Notice: An active Internet Website was established at www.kdheks.gov/tmdl/ to convey information to the public on the general establishment of TMDLs and specific TMDLs for the Lower Arkansas River Basin.

Public Hearing: A Public Hearing on this TMDL was held on September 4, 2013 in Newton to receive public comments. No comments were received from the public regarding this TMDL.

Basin Advisory Committee: The Lower Arkansas River Basin Advisory Committee met to discuss the TMDLs in the basin on September 12, 2012 in Halstead and on April 3, 2013 in Hutchinson, KS.

Milestone Evaluation: In 2017, evaluation will be made as to the degree of implementation which has occurred within the watershed. Subsequent decisions will be made through the Little Arkansas River WRAPS, regarding the implementation approach and follow up of additional implementation in the watershed.

Consideration for 303(d) Delisting: The Little Arkansas River will be evaluated for delisting under Section 303(d), based on the monitoring data over the period 2012-2021. Therefore, the decision for delisting will come about in the preparation of the 2022-303(d) list. Should modifications be made to the applicable water quality criteria during the ten-year implementation period, consideration for delisting, desired endpoints of this TMDL and implementation activities may be adjusted accordingly.

Incorporation into Continuing Planning Process, Water Quality Management Plan and the Kansas Water Planning Process: Under the current version of the Continuing Planning Process, the next anticipated revision would come in 2015, which will emphasize implementation of WRAPS activities. At that time, incorporation of this TMDL will be made into the WRAPS. Recommendations of this TMDL will be considered in the Kansas Water Plan implementation decisions under the State Water Planning Process for Fiscal Years 2012-2021.

Rev May 28, 2014

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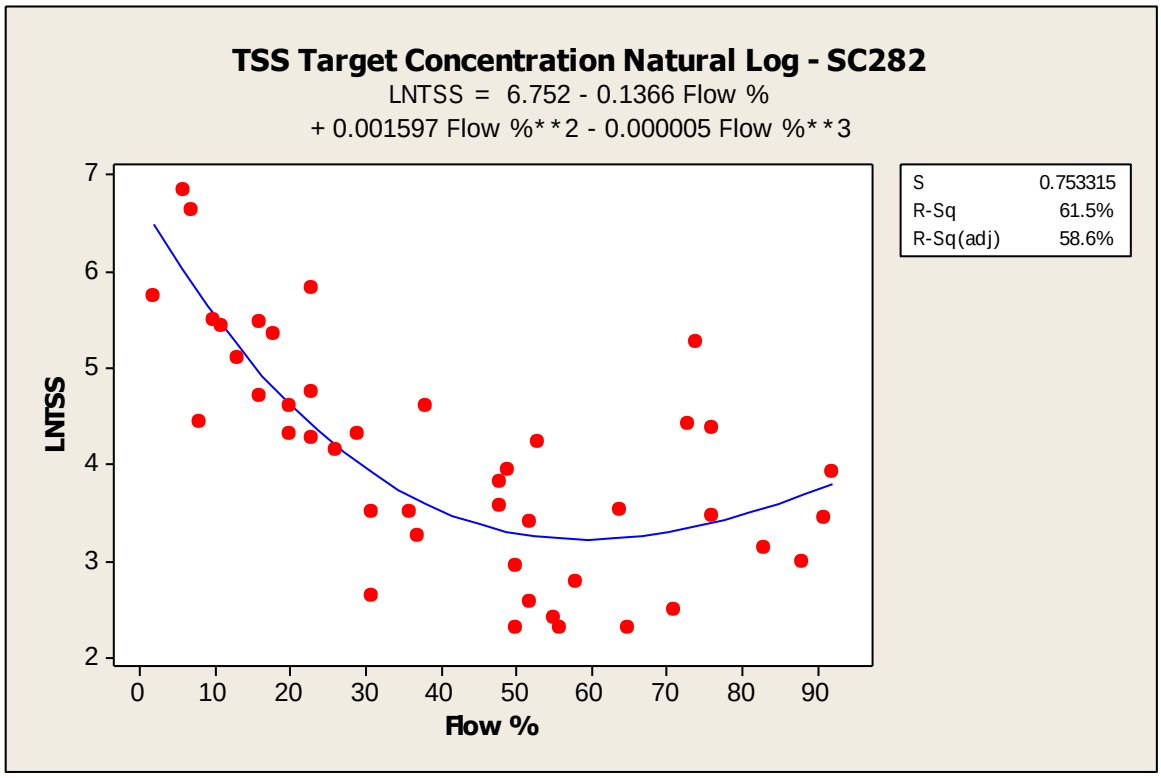
Appendix A. NDPES Facilities within the Little Ark R watershed.

KS Permit #	Facility	NPDES #	Permit Expires	WLA (tons/day)
I-LA02-PO02	WICHITA ASR PHASE I TREATMENT PLANT	KS0099392	12/31/2017	In Reserve
I-LA07-PO02	AGCO CORPORATION	KS0080951	10/31/2017	0.03
I-LA07-PR01	BUILDERS CONCRETE & SUPPLY / HESSTON	KSG110032	9/30/2017	0
I-LA11-CO03	BPU-(MCPHERSON) POWER PLANT #3	KS0093602	12/31/2012	0
I-LA11-PO02	NCRA REFINERY - MCPHERSON	KS0000337	3/31/2017	0.43
I-LA11-PO04	BPU-MCPHERSON #2	KS0079758	12/31/2012	0.02
I-LA11-PO09	BPU-(MCPHERSON) WT AIR STRIPPER	KS0088625	12/31/2012	0
I-LA11-PR01	MCPHERSON CONCRETE PRODUCTS-WEST PLANT	KSG110090	9/30/2017	0
I-LA11-PR02	MID AMERICA READY MIX - MCPHERSON EAST	KSG110092	9/30/2017	0
I-LA13-PO01	BNSF RAILWAY CO - NEWTON	KS0001082	1/31/2017	0
I-LA13-PR01	BUILDERS CONCRETE - NEWTON FACILITY	KSG110009	9/30/2017	0
I-LA13-PR02	PRESTRESSED CONCRETE - NEWTON FACILITY	KSG110006	9/30/2017	0
I-LA20-PR01	KANSAS READY MIX - WICHITA	KSG110198	9/30/2017	0
I-LA22-PO01	WESTAR ENERGY - HUTCHINSON ENERGY CTR	KS0079723	1/31/2014	0.03
I-LA24-PO01	WICHITA ASR PHASE II TREATMENT PLANT	KS0099694	12/31/2014	In Reserve
M-LA01-OO01	BUHLER, CITY OF	KS0027553	7/31/2017	0.02
M-LA02-OO01	BURRTON, CITY OF	KS0049786	12/31/2015	0.05
M-LA03-OO01	GALVA, CITY OF	KS0022560	9/30/2017	0.02
M-LA04-OO02	GENESEO, CITY OF	KS0098175	12/31/2013	0.01
M-LA05-OO02	GOESSEL, CITY OF	KS0081060	9/30/2017	0.03
M-LA06-OO01	HALSTEAD, CITY OF	KS0026263	7/31/2017	0.05
M-LA07-OO01	HESSTON, CITY OF	KS0022799	1/31/2017	0.16
M-LA08-OO01	INMAN, CITY OF	KS0080292	6/30/2016	0.04
M-LA09-SU01	KECHI, CITY OF	KSR041013	9/30/2009	MS4
M-LA10-OO02	LITTLE RIVER, CITY OF	KS0085758	9/30/2015	0.03
M-LA11-OO01	MCPHERSON, CITY OF	KS0036196	8/31/2017	0.25
M-LA11-SN01	MCPHERSON, CITY OF	KSR044013	9/30/2009	MS4
M-LA12-OO01	MOUNDRIDGE, CITY OF	KS0021008	12/31/2017	0.08
M-LA13-IO01	NEWTON, CITY OF	KS0038971	12/31/2012	0.38
M-LA13-SN01	NEWTON, CITY OF	KSR044014	9/30/2009	MS4
M-LA15-OO02	SEDGWICK, CITY OF	KS0081108	7/31/2017	0.04
M-LA16-OO02	VALLEY CENTER, CITY OF	KS0099074	6/30/2017	0.01
M-LA16-SU01	VALLEY CENTER, CITY OF	KSR041037	9/30/2009	MS4
M-LA17-OO01	WALTON, CITY OF	KS0026140	6/30/2017	0.01
M-LA18-OO01	WINDOM, CITY OF	KS0051721	1/31/2017	0.01
M-LA19-OO02	CHISHOLM CREEK UTILITY AUTHORITY	KS0089176	12/31/2017	0.27
M-LA19-SU01	PARK CITY, CITY OF	KSR041027	9/30/2009	MS4
P-LA07-IO01	EXCEL INDUSTRIES, INC.	KSP000046	6/30/2015	0
P-LA12-OO01	MORIDGE MANUFACTURING, INC.	KSP000088	6/30/2015	0
P-LA13-OO01	BUNTING MAGNETICS	KSP000103	6/30/2015	0
P-LA15-OO01	UNRUH FAB, INC.	KSP000091	6/30/2016	0
P-LA19-OO01	HAYES COMPANY INC.	KSP000056	12/31/2014	0
P-LA19-OO02	KICE INDUSTRIES, INC.	KSP000101	6/30/2014	0
C-AR49-NO01	VICTORY VILLAGE	KSJ000599	6/30/2013	0
C-AR69-NO01	81 SPEEDWAY	KSJ000193	10/31/2013	0
C-LA03-NO03	SUNFLOWER SCHOOL	KSJ000211	8/31/2016	0
C-LA06-NO02	SPRING LAKE RESORT	KSJ000564	11/30/2016	0
C-LA06-NO03	GARDENVIEW MENNONITE CHURCH	KSJ000565	11/30/2017	0
C-LA07-NO01	COOK'S MOBILE HOME COURT	KSJ000199	5/31/2016	0
C-LA12-NO01	MJ'S TRUCK REPAIR LLC	KSJ000566	1/31/2016	0
C-LA13-NO08	PAYNE OIL COMPANY, INC.	KSJ000553	3/31/2016	0
C-LA13-NO10	SCHMIDT INDUSTRIAL PARK WTF	KSJ000152	11/30/2016	0
C-LA16-NO01	COUNTRY ACRES TRAILER COURT	KSJ000555	4/30/2016	0
C-LA16-NO02	BAKER FURNITURE & CARPET (CLOSED)	KSJ000556	8/31/2015	0
C-LA16-NO03	NORTH STAR RV PARK & MOBILE HOME COMMUN	KSJ000174	10/31/2016	0
I-LA11-NO06	KREHBIEL SPECIALTY MEATS, INC.	KSJ000103	1/31/2016	0
I-LA11-NP01	JOHNS MANVILLE CORP.- MCPHERSON	KSJ000503	12/31/2012	0
I-LA13-NO03	FULL VISION, INC.	KSJ000502	6/30/2016	0
I-LA13-NO08	APAC-KANSAS / SHEARS (PLANT #912)	KSJ000203	6/30/2016	0
I-LA13-NO09	ACH FOAM TECHNOLOGIES	KSJ000170	7/31/2018	0
M-AR49-NO03	RENO CO. BLUE SPRUCE S.D. #3 AND #10	KSJ000453	8/31/2013	0
M-AR49-NO05	RENO CO. S.D. #8	KSJ000454	6/30/2013	0
M-LA13-NO01	KDOT - HARVEY CO. REST STOP	KSJ000383	11/30/2016	0
M-LA13-NO03	CAMP HAWK	KSJ000554	7/31/2016	0

Appendix B. Cubic Regression of TSS samples at SC282 on the Little Arkansas River at Valley Center for the years with full support for the MBI and %EPT biotic indices.



Appendix C. Registered, certified or permitted CAFOs in the Little Arkansas R. watershed.

State PERMIT (NPDES)	FAC_COUNTY	ANI_TOTAL_	PERMIT_ANI	PERMIT_A_1	WLA
A-LAHV-S020	Harvey	400	Swine	Swine0-299	0
A-LAHV-B006	Harvey	202	Beef,Horses	0-299,0-299	0
A-LAHV-BA02	Harvey	400	Beef	300-999	0
A-LAHV-S005	Harvey	1048	Swine,Beef	Swine0-299,0-299	0
A-LAHV-B009	Harvey	3000	Beef	1000-9999	0
A-LAHV-S003	Harvey	1100	Swine,Beef	Swine0-299,0-299	0
A-LAHV-MA01	Harvey	20	Dairy	0-299	0
A-LAHV-B005	Harvey	800	Beef	300-999	0
A-LAMP-MA02	Mcpherson	40	Dairy	0-299	0
A-LAMP-BA19	Mcpherson	150	Beef	0-299	0
A-LAMP-M002	Mcpherson	220	Dairy	0-299	0
A-LAMP-BA18	Mcpherson	147	Beef	0-299	0
A-LAMP-M005	Mcpherson	336	Dairy	300-999	0
A-LAMP-MA03	Mcpherson	30	Dairy	0-299	0
A-LAMP-B001	Mcpherson	600	Beef	300-999	0
A-LAMP-MA01	Mcpherson	35	Dairy	0-299	0
A-LAMP-K001	Mcpherson	150	Kennel	Kennel0-999999	0
A-LAMP-M022	Mcpherson	87	Dairy	0-299	0
A-ARRC-S007	Rice	2700	Swine	Swine300-999	0
A-LARC-S003	Rice	3300	Swine	Swine300-999	0
A-LARC-B001	Rice	2400	Beef	1000-9999	0
N-LAMP-4807	Mcpherson	100	Beef	0-299	0
A-LAMP-P004 (KS0097900)	Mcpherson	30303	Laying Hens LM	1000-9999	0
A-LAMP-B002	Mcpherson	915	Beef	300-999	0
A-LAMP-M032	Mcpherson	150	Dairy	0-299	0
A-LAMP-SA01	Mcpherson	350	Swine	Swine0-299	0
A-LAMP-S024	Mcpherson	1414	Swine,Beef	Swine0-299,300-999	0
A-LAHV-T001	Harvey	0	TruckwashP-2	0-299	0
A-LAHV-BA04	Harvey	100	Beef	0-299	0
A-LAHV-M008	Harvey	50	Dairy	0-299	0
A-LAHV-F005	Harvey	7300	Turkeys	0-299	0
A-LAHV-L001	Harvey	750	Sheep,Goats	0-299,0-299	0
A-LAMP-S029	Mcpherson	3500	Swine	Swine300-999	0
A-LAHV-C003 (KS0085863)	Harvey	1500	Beef	1000-9999	0
A-LAHV-S033	Harvey	1800	Swine	Swine300-999	0
A-LAHV-S034	Harvey	1500	Swine	Swine300-999	0
A-LAHV-S039	Harvey	500	Swine,Beef	Swine0-299,0-299	0
A-LAMP-B003	Mcpherson	401	Beef,Horses	300-999,0-299	0
A-LAMP-S025	Mcpherson	2000	Swine	Swine300-999	0
A-LAMP-M026	Mcpherson	20	Dairy	0-299	0
A-LARN-H002	Reno	5400	Swine	Swine1000-3724	0

(KS0098680)					
A-LAMP-FA02	Mcpherson	6000	Turkeys	0-299	0
A-LAHV-S037	Harvey	6400	Swine	Swine300-999	0
A-LAMP-S026	Mcpherson	2600	Swine,Beef	Swine300-999,0-299	0
A-LAMN-B001	Marion	800	Beef	300-999	0
A-LAMN-BA04	Marion	40	Beef	0-299	0
A-LAHV-BA22	Harvey	300	Beef	300-999	0
A-NEMP-BA02	Mcpherson	520	Beef,Horses	0-299,0-299	0
A-LASG-BA01	Sedgwick	100	Beef	0-299	0
A-LAMP-BA14	Mcpherson	75	Beef	0-299	0
A-LAMN-B002	Marion	750	Beef	300-999	0
A-LAMP-BA04	Mcpherson	100	Beef	0-299	0
A-LAMP-BA01	Mcpherson	700	Beef	300-999	0
A-LAHV-BA12	Harvey	50	Beef	0-299	0
A-WAHV-BA11	Harvey	500	Beef	300-999	0
A-LAMP-FA01	Mcpherson	33000	Chickens NL,Beef	0-299,0-299	0
A-LAMP-BA05	Mcpherson	400	Beef	300-999	0
A-WAHV-BA08	Harvey	100	Beef	0-299	0
A-LAHV-BA15	Harvey	350	Beef	300-999	0
A-LAMN-BA01	Marion	200	Beef	0-299	0
A-LAHV-BA20	Harvey	950	Beef	300-999	0
A-LAHV-B007	Harvey	300	Beef	0-299	0
A-LAHV-M010	Harvey	225	Dairy	300-999	0
A-LAMP-BA15	Mcpherson	300	Beef	300-999	0
A-LAMP-BA16	Mcpherson	500	Beef	300-999	0
A-LAHV-BA08	Harvey	20	Beef	0-299	0
A-LAHV-BA06	Harvey	450	Beef	300-999	0
A-LAHV-M009	Harvey	140	Dairy	0-299	0
A-LAHV-MA05	Harvey	100	Dairy	0-299	0
A-LAMN-BA03	Marion	180	Beef	0-299	0
A-LAHV-FA02	Harvey	6000	Turkeys	0-299	0
A-LAMP-M028	Mcpherson	197	Dairy	0-299	0
A-LAHV-SA04	Harvey	350	Swine	Swine0-299	0
A-LAHV-BA14	Harvey	340	Beef	0-299	0
A-LAMP-BA06	Mcpherson	300	Beef	300-999	0
A-LAMP-BA17	Mcpherson	30	Beef	0-299	0
A-LAMP-S031	Mcpherson	965	Swine	Swine0-299	0
A-LAMP-BA07	Mcpherson	100	Beef	0-299	0
A-LAMP-S028	Mcpherson	610	Swine	Swine0-299	0
N-LAMP-6197	Mcpherson	300	Dairy	300-999	0
A-LAHV-BA17	Harvey	980	Beef	300-999	0
A-LARC-S005	Rice	4086	Swine	Swine300-999	0
A-ARRN-BA09	Reno	500	Beef	0-299	0
A-LAHV-SA05	Harvey	375	Swine,Beef	Swine0-299,0-299	0
A-LAMN-BA02	Marion	20	Beef	0-299	0
A-SHMP-BA06	Mcpherson	100	Beef	0-299	0
A-LAHV-BA18	Harvey	25	Beef	0-299	0
A-LAHV-MA03	Harvey	75	Dairy	0-299	0

A-LAMP-S034	Mcpherson	850	Swine,Beef	Swine300-999,0-299	0
A-LAMP-BA08	Mcpherson	75	Beef	0-299	0
A-ARSG-MA04	Sedgwick	75	Dairy	0-299	0
N-LAMP-6371	Mcpherson	150	Beef	0-299	0
A-LAMP-B004	Mcpherson	200	Beef	0-299	0
A-LAMP-M027	Mcpherson	315	Dairy	300-999	0
A-LAHV-BA11	Harvey	200	Beef	0-299	0
A-LAHV-S038	Harvey	71	Swine	Swine0-299	0
A-LAHV-BA16	Harvey	500	Beef	300-999	0
A-LAHV-BA09	Harvey	500	Beef	300-999	0
A-LAHV-C004 (KS0098248)	Harvey	2000	Beef	1000-9999	0
A-LAMP-FA03	Mcpherson	27400	Chickens NL	0-299	0
A-LAHV-BA07	Harvey	50	Beef	0-299	0
A-LAMP-BA11	Mcpherson	200	Beef	0-299	0
A-LAMP-BA10	Mcpherson	20	Beef	0-299	0
A-LAMP-BA12	Mcpherson	200	Beef	0-299	0
A-NEMN-BA32	Marion	400	Beef	300-999	0
A-LARC-MA01	Rice	40	Dairy	0-299	0
A-LAMP-BA09	Mcpherson	150	Beef	0-299	0
A-LARN-BA01	Reno	30	Beef	0-299	0
A-LAHV-H002 (KS0094331)	Harvey	3000	Swine	Swine1000-3724	0
A-LAHV-BA05	Harvey	100	Beef	0-299	0
A-LAMP-BA03	Mcpherson	250	Beef	0-299	0
A-LAMP-BA13	Mcpherson	60	Beef	0-299	0
A-ARRN-M050	Reno	60	Dairy	0-299	0
A-LAMP-BA02	Mcpherson	250	Beef	0-299	0
A-LAMP-M030	Mcpherson	205	Beef,Dairy	0-299,0-299	0
A-LAMN-S001	Marion	3000	Swine	Swine300-999	0
A-LAMP-S030	Mcpherson	2000	Swine	Swine0-299	0
A-LARC-S006	Rice	3690	Swine	Swine300-999	0
A-LAHV-F004	Harvey	7000	Turkeys	0-299	0
A-LAMP-S032	Mcpherson	4800	Swine	Swine300-999	0
A-LARC-BA01	Rice	100	Beef	0-299	0
A-LAHV-BA21	Harvey	500	Beef	0-299	0
A-LAMP-PA01	Mcpherson	6500	Turkeys	0-299	0
825	Mcpherson	300	Beef	0-299	0
A-LAHV-M011	Harvey	120	Dairy	0-299	0
A-LAMP-S015	Mcpherson	950	Swine,Beef	Swine300-999,0-299	0
965	Mcpherson	700	Beef	300-999	0
A-LAHV-FA03	Harvey	7000	Turkeys	0-299	0
A-LAMP-F004	Mcpherson	7300	Turkeys	0-299	0
A-LAMP-S036	Mcpherson	2400	Swine	Swine300-999	0